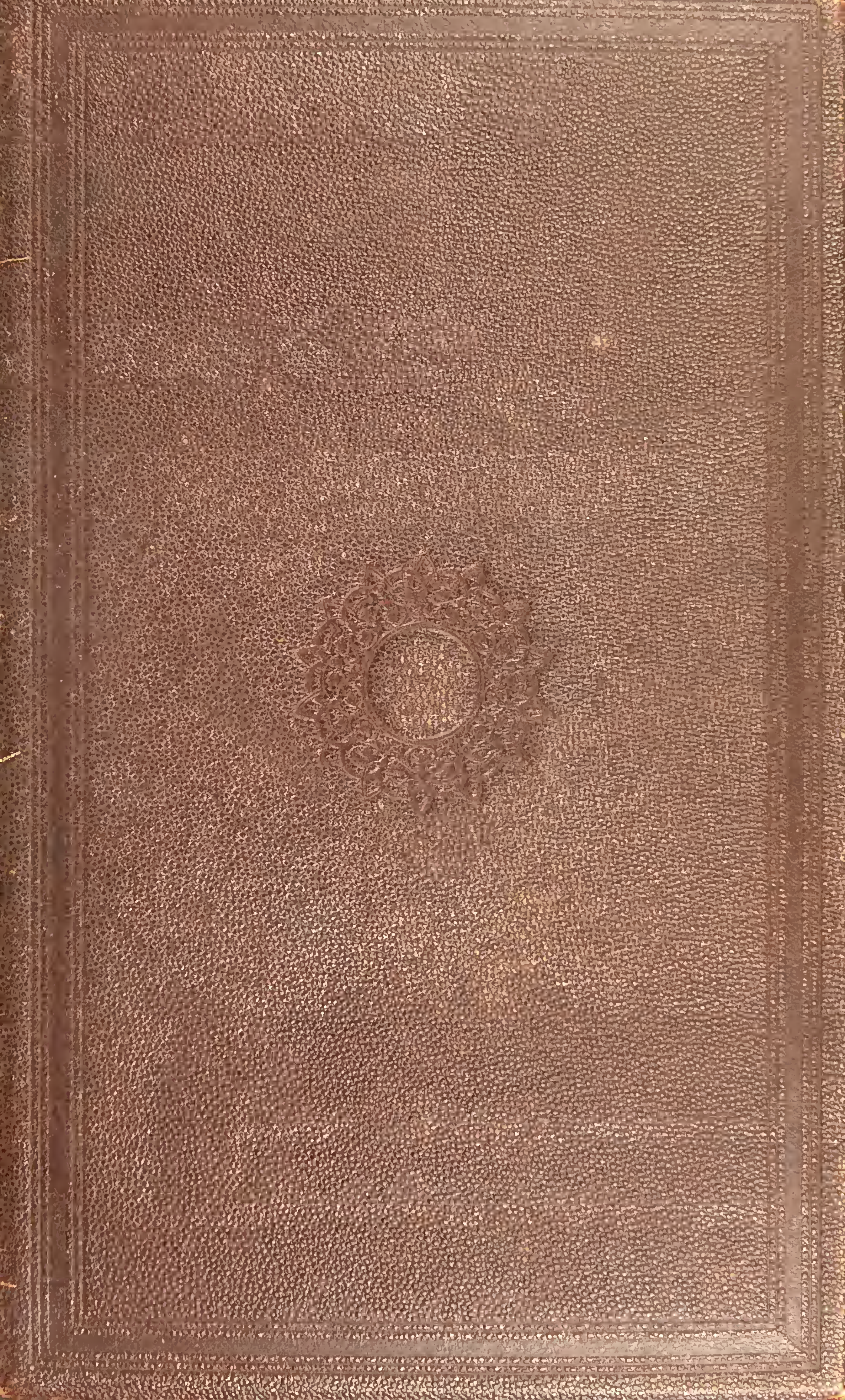

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CYCLOPÆDIA

OF THE

PRACTICE OF MEDICINE.

EDITED BY DR. H. VON ZIEMSSEN,
PROFESSOR OF CLINICAL MEDICINE IN MUNICH, BAVARIA.

VOL. III.

CHRONIC INFECTIOUS DISEASES.

BY PROF. CHRISTIAN BÄUMLER of Erlangen, PROF.
ARNOLD HELLER of Kiel, AND PROF. OTTO
BOLLINGER of Munich.

Translated by

ARTHUR H. NICHOLS, M.D., of Boston; WILLIAM ASHBRIDGE, M.D., of Philadelphia;
JAMES G. HYNDMAN, M.D., of Cincinnati; AND EDWARD B. BRONSON,
M.D., AND EDWARD L. KEYES, M.D., of New York.

ALBERT H. BUCK, M.D., NEW YORK,
EDITOR OF ENGLISH TRANSLATION.

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BIOGRAPHICAL SKETCHES OF THE AUTHORS.

Christian Bäumler, Professor of Materia Medica and Director of the Polyclinic at Freiburg (Baden), was born in 1836, at Buchau (Upper Franconia). His early education was completed at the High School of Nuremberg, and he studied medicine in the Universities of Erlangen, Tübingen, Berlin, Prague, and Vienna. He graduated at Erlangen in 1860, and for over two years held the post of assistant-physician to the polyclinic of this university. Afterwards he went to Paris and London, and from 1863 to 1866 was resident medical officer at the German Hospital, London. In the latter year he became a member of the Royal College of Physicians, London, and practised in London from 1866 to 1872, at the same time acting as assistant-physician to the German Hospital and the Victoria Park Hospital for Diseases of the Chest. In 1872 he was called to a Chair of Medicine in the University of Erlangen, and in the autumn of 1874 to Freiburg.

He is the author of "A Thesis on the Function of the Intercostal Muscles," Erlangen, 1860; of papers "On Coloboma Oculi," Würzb. med. Zeitschr., 1862; "On Tympanitic Resonance in Pneumonia," Deutsches Arch. für klin. Medicin, Vol. I., 1865; "On Typhoid Fever in England," Ibid., Vol. III., 1867; "On the Observation of Temperature as a Means of Diagnosis in Cases of Syphilis," Ibid., Vol. IX., 1871; and of various other contributions to the same journal, and to the Medical Times and Gazette, the British Medical Journal, the Transactions of the Clinical and Pathological Societies of London. He was the translator of Niemeyer's lectures on Consumption into English for the New Sydenham Society.

Arnold Heller, Professor of General Pathology and Pathological Anatomy at the University of Kiel, was born in the year 1840, in Klein-Haubach-on-the-Main in Bavaria. He studied medicine in Erlangen and Berlin, received the degree of Doctor in 1866, and served as an army surgeon during the war of 1866. In further pursuance of his studies he visited Vienna, Prague, and Leipsic, in the former working under Rokitansky, and in the latter under Ludwig. During the war of 1870–71 he was active as a volunteer in caring for the sick and wounded. During the interval from 1866 to 1872 he was assistant at the Pathological Institute in Erlangen; in 1869 he received the position of Private Instructor; in 1871 he visited England and Scotland; in 1872 he was called to Kiel. He has contributed the following articles to journals: "On the Anatomical Grounds for the Disturbances of Hearing in Cerebro-spinal Meningitis," in the Deutsches Archiv f. klin. Med., Band III.; "Pneumonia and Meningitis," Ibid., Band V. (written conjointly with Professor Zimmermann, of Basle); "Metastatic Processes of the Liver," Ibid., Band VII.; "Skleroderma," Ibid., Band X.; "Hydronephroses," Ibid., Band V., VI.; "Multiple Neuromata," Virchow's Archiv, Band 44; "On Inflammation and Suppuration," Erlangen, 1869, Ibid., Band 40; "On Rhythmic Lymphatic Pulse," Med. Central-Bl., 1869; "On the Blood-vessels of the Small Intestine," Arbeit. d. Phys. Instit. zu Leipsig, 1872. He has also published a number of minor articles in the Deutsches Archiv f. klin. Med., in Virchow's Archiv, and in the Sitzungsberichte d. physical. und medicin. Gesellschaft of Erlangen.

Otto Bollinger, the son of a Protestant minister, was born on the 2d of April, 1843, at Altenkirchen, in the Rhenish Palatinate of Bavaria. After completing his studies at the High School of Zweibrücken, he entered the University of Munich in the autumn of 1862, and devoted himself to the study of medicine until 1868. From the year 1863 to 1868 he also acted as assistant under Professor Buhl, of the Pathological and Anatomical Institute of the University. Without taking his degree or passing the state examination he visited Vienna and Berlin, where, during the years 1868 and 1869, he completed his medical studies, and immediately commenced in those cities the study of comparative pathology and veterinary medicine. Returning to Munich he continued his studies at the veterinary school of the latter city, and in the summer of 1870 became Private Instructor in comparative pathology at the University of Munich. When the Franco-German war broke out he entered the Bavarian service for the war, as a volunteer surgeon of a battalion. In this capacity he served during the whole campaign in France. After the war was ended he accepted a call, made before the war, and became Professor at the Veterinary School in Zurich, acting at the same time at the University as Private Instructor in Comparative Pathology; he also gave instruction as Professor of Epidemiology in the agricultural department of the Confederate Polytechnic Institute. After three years of active devotion to these subjects in Zurich, he accepted a call as Extraordinary Professor of Comparative Pathology at the University of Munich, and also as Professor of General Pathology at the Central Veterinary School of Munich, both of which positions he has been filling since the Spring of 1874. The more important of his scientific works are the following: 1. "Contributions to Comparative Pathology," Part I. "The Colic of Horses and Vermiform Aneurism of Enteric Arteries" (with 19 wood-cuts), Munich, 1870, Part II. "On the Pathology of Malignant Pustule" (with 3 plates), Munich, 1872. 2. "Statistics of Changes of Old Standing in Human Bodies." 3. "On the Pathological Anatomy of Acute Atrophy of the Liver and Phosphorus Poisoning." 4. "A Case of Phosphorus Poisoning." Deutsches Arch. f. klin. Med., Vols. V. and VI., 1869 and 1869. 5. "On Peculiar Bodies in the Minute Arteries of Horses," Virchow's Arch., Vol. 47, 1869. 6. "Mycosis of the Lungs in Horses," Ibid., Vol. 49, 1870. 7. "A Contribution to our Knowledge of the Rinderpest," Arch. f. Thierheilkunde, Band 24, 1871. 8. "Contributions to Comparative Pathological Anatomy:" I. "On the Pathological Anatomy of Hydrophobia;" II. "Miliary Tuberculosis in the Cat," Virchow's Arch., Band 55, 1872. 9. "On the Tuberculosis resulting from Inoculations and Feeding with Tubercular Matter," Arch. f. Exper. Path., Bd. I., 1873. 10. "A Contribution to our Knowledge of the Lameness of Foals," Virchow's Arch., Bd. 58, 1873. 11. "On Epithelioma Contagiosa in the Domestic Fowls and the so-called Pox in Birds," Ibid. 12. "On Leukaemia of Domestic Animals," Virchow's Arch., Bd. 59, 1874. 13. "On the Syphilis of the Wild Hares," Ibid., Bd. 59, 1874.

ERRATA.

VOL. II.

On page 92, at the beginning of the fifth line from the bottom, a comma has been omitted after the word "bronchi."

On page 231, fifteenth line from the top, the word "chest" should be used instead of "heart."

On page 317, the word "modificaitons" should read "modifications."

On page 538, sixth line from the top, "(1 : 50–60)" read "(one grain to the fluid drachm)."

On page 662, foot-note, for "pills............doses," read "pills containing equal parts of sulphate of cinchona and saccharated carbonate of iron, of which from twenty-three to thirty grains are taken through the day in hourly doses."

On page 663, sixth line from the top, for "180" read "185;" seventh line from the bottom, for "Barnatzik" read "Bernatzik."

On page 664, last line of foot-note, for "(10 lbs. 8 ounces to the bath)" read "(one hundred and twenty-nine American, or one hundred and forty-one British ounces to the bath)."

On page 665, second line from the bottom, for "chinoidine" read "quinoidine"; in second foot-note, for "Quinodine" read "Quinoidine."

On page 670, eleventh line from the top, for "180" read "185."

On page 677, in the foot-note, for "bebeerine" read "berberine"; and for "3½ to 15 grains" read "from three to fifteen grains."

On page 737, at the top, for "narcottic" read "narcotic."

VOL. III.

On page 347, sixth text-line from foot, "(bromide and iodide of potassium, chlorate of potassa)," should read "(bromide, chloride and iodide of potassium)."

On page 370, second line from the bottom, "bichlorate" should read "chloride;" and same page, last line, "potash" should read "potassium."

On page 371, top line, "potash" should read "potassium."

On page 452, last line, "disordered" should read "perverted."

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BOLLINGER.

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(Translated by James G. Hyndman.)

SYPHILIS.

BÄUMLER.

LEEDS & WEST-RIDING
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INTRODUCTION.

Recent general works upon syphilis: *Ricord*, Traité complet des maladies vénériennes. Clinique iconographique de l'hôpital des vénériens. Paris, 1842–52. —*Simon*, Art. "Syphilis," in Virchow's Handbuch der spec. Pathol. u. Ther., Bd. II., 1, 1855, p. 421.—*Freeman J. Bumstead*, The Pathology and Treatment of Venereal Diseases. 2 edit. Philadelphia, 1864.—*Michaelis*, Compendium der Lehre von der Syphilis, 2 Aufl. Wien, 1865.—*Jonathan Hutchinson*, "Constitutional Syphilis," in J. Russell Reynolds' System of Medicine, Vol. I. p. 287. London, 1866.—*A. Geigel*, Geschichte, Pathologie und Therapie der Syphilis. Würzburg, 1867.—*Berkeley Hill*, Syphilis and Local Contagious Disorders. London, 1868.—*Henry Lee*, "Syphilis," in Holmes' System of Surgery, 2d ed., Vol. I. p. 395. London, 1870.—*C. v. Sigmund*, Syphilis und venerische Geschwürsformen. Pitha and Billroth's Handbuch der allgem. u. speciellen Chirurgie, B. I., 2, p. 204, 1872.—*H. Zeissl*, Lehrbuch der Syphilis, 2 Aufl. Erlangen, 1872.—*A. Fournier*, Leçons sur la syphilis étudiée plus particulièrement chez la femme. Paris, 1873.—*E. Lancereaux*, Traité historique et pratique de la syphilis, 2d edit., Paris, 1874, containing a very complete bibiliography.

By the term *syphilis* we understand a chronic, infectious disease, whose course, though protracted, is not, on this account, less typical than that of other infectious diseases. But in syphilis the different stages lie so far removed from each other that the connection between their symptoms is not at once manifest. For this reason, certain symptoms of the disease were for a long time not recognized as belonging to syphilis.

The disease consists, essentially, in an intoxication, which proceeds from a local infection, and gradually pervades the entire organism, manifesting itself in all the various tissues of the body under the form of an inflammatory process, of greater or less intensity, which, to a certain extent, pursues a course peculiar to itself.

The mode in which the disease commonly propagates itself has tended not a little to impede its study, and, chiefly, because in the past attention has been directed solely to local processes that take place at the point where the poison gains entrance, to the neglect of changes occurring in the body at large. Furthermore, a number of local affections, having no connection whatever with syphilis, were for a long time confounded with it. Etiologically speaking, syphilis and morbus venereus are not synonymous terms; syphilis may be a morbus venereus—as, in fact, it is in the great majority of instances—but not necessarily. The only conditions necessary to the inception of the disease are the presence of the specific poison and its inoculation at any part of the skin or mucous membrane of a healthy, that is, not yet syphilitic person, though the disease may also be inherited.

Whenever the meaning attached to a term is clearly defined, the latter may be retained, even though its lack of intrinsic significance or other considerations, such as, perhaps, apply particularly to the disease which we are now considering, might seem to render a change of name desirable. The term "syphilis" was probably invented with reference, etymologically, to the most frequent mode of origin of the disease, and was first employed, incorporated in a myth, by the Veronese physician Hieronymus Fracastorius,[1] who relates, in a poem concerning the disease, that a herdsman of king Alkithous, Syphilus by name, was afflicted with it by Apollo, in punishment for paying divine homage to the king instead of to the god. Other names employed in the fifteenth and sixteenth centuries were: *Morbus gallicus* (by the Italians, Germans, and Spaniards), *Morbus neapolitanus* by the French, who, however, as early as at the end of the fifteenth century, called the disease "*la grosse vérole.*" In Spain the popular term was "*bubas*" (pox); in Germany: *Welsche Bossen* or *Purpeln*, also *mala franzos.* The older writers also employ the names *Lues venerea* (Fernelius, 1556), *mentagra* (mentulagra), and *Pudendagra*, *Patursa* (passio turpis Saturnina), and others.

---

[1] *H. Fracastorii*, Veronensis: Syphilis sive morbus gallicus. Lib. III. Written in 1521. Printed in the collection of A. Luisinus. F. does not himself give any etymology of the term he employs, but *Gabr. Fallopia*, de morb. gall., Aphr. II. p. 763, says: "Hic vocavit syphila morbum istum, quia ex amore....ut plurimum suboritur."

HISTORY.

Most of the writings which had appeared upon syphilis at the end of the fifteenth century, and up to the middle of the sixteenth century, are collected in the work, first published in 1566, in Venice, by Aloysius Luisinus, De morbo Gallico omnia quæ exstant, etc. A third edition of this collection was prepared by Boerhaave under the title, Aphrodisiacus sive de lue venerea, etc. Lugd. Batav., 1728. A third volume, with other supplements, was published by Ch. G. Gruner, in 1788, and still later, up to the year 1802.—*J. Astruc*, De morbis venereis libri VI. Paris, 1736.—*Ch. Girtanner*, Abhandlung über die vener. Krankheit. Göttingen, 1789.—*C. H. Fuchs*, Die ältesten Schriftsteller über die Lustseuche in Deutschland von 1495 bis 1510. Göttingen, 1843.—*Ph. G. Hensler*, Geschichte der Lustseuche. Altona, 1783.—*J. Rosenbaum*, Die Lustseuche im Alterthum. Halle, 1839.—*G. L. Dieterich*, Die Krankheitsfamilie Syphilis, I. Band. Landshut, 1842.—*P. L. A. Cazenave*, Traité des Syphilides. Paris, 1843.—*F. A. Simon*, Versuch einer kritischen geschichte, etc. Hamburgh, 1830–46.—*H. Friedberg*, Die Lehre von den venerischen Krankheiten in dem Alterthum und Mittelalter. Berlin, 1865.—*H. Haeser*, Lehrbuch der Geschichte der Medicin, 2 Aufl. Jena, 1859. 3 Aufl., 1 Band, 1 Lief., 1874.—*A. Hirsch*, Handbuch der histor. geograph. Pathologie. Erlangen, 1860. 1 Band.—*F. W. Müller*, Die venerischen Krankheiten im Alterthum. Erlangen, 1873.—*D. Bonifacio Montejo*, La sifilas y las enfermedades que se han confudido con ella, Madrid, 1863–64 and 1870, was, however, not accessible to me; references to it to be found in Notes on the History of Syphilis, by George Gaskoin; Medical Times and Gazette, 1876, Vol. II. pp. 62, 89, 115, 200, and in Die Deutschen Klinik, 1873. Nos. 49, 50, and 51.—*Edm. Bassereau*, Origine de la Syphilis. Paris, 1873.

The first knowledge of syphilis, as a separate and distinct disease, dates from the end of the fifteenth century, from that notorious and epidemic-like outbreak of the disease in Italy, between the years 1490 and 1500. From the numerous writings which appeared in the latter part of the fifteenth century, and in the beginning of the sixteenth, it is evident that the physicians regarded it as a new disease.[1] Its origin is, by common consent, traced by them to the army of Charles VIII. of France, who had been in Italy since September 1494, and 1494–5 was besieging

---

[1] *Nicolaus Leonicenus* writes in 1497: "Insolitæ naturæ morbus Italiam et multas alias regiones invasit." Aphrodis.. I. p. 18.—*Laurentius Phrisius*, in 1530: "Nam incognitus et invisus erat iste pestifer morbus non tantum vulgo, verum etiam doctis et in sacra medicina eruditis." Aphr., I. p. 344.

Naples. The disease is reported (according to J. de Vigo, in December, 1494) to have broken out among the soldiers of the besieging army to an alarming extent, and in an exceedingly severe form.

The earliest description of the disease comes from Marcellus Cumanus, an army surgeon from Venice, who observed it in 1495 among the soldiers besieging Novara. He describes as symptoms of the affection ulcers of the genitals, violent pains in the arms and legs, and eruptions of the skin, which, without treatment, would sometimes last for years.

Various attempts were made to account for the apparently sudden prevalence of the disease. While most physicians, as Conradinus Gilinus, in 1497,[1] recognized the starting-point of the affection to be in the genitals, and regarded impure sexual congress as the most important element in the etiology, yet this to many seemed insufficient to account for the suddenness of the outbreak, and the rapid, universal spread of the disease. By some the stars were blamed as the source of the evil, and since, in the year 1483, an exceedingly ominous constellation had made its appearance, they did not hesitate to ascribe the origin of the disease to it (as Wendelin Hock de Brackenau, for example). Corruption of the atmosphere was assumed by others to be the cause of the outbreak. More especially, perhaps, in order to account for the attacking of monks and nuns, or persons of elevated rank in the church, was the air considerately regarded as the medium of contagion. Atmospheric conditions were advanced as the source of the epidemic, by various writers, and it was especially noted that 1494 was an exceedingly wet year, during which many regions were flooded, and among others Rome itself.[2]

That such an event as the discovery of America should have been thought of, in the effort to explain the sudden outbreak of a hitherto unknown disease, is not at all strange; on the contrary, it is rather remarkable that so long a time should have elapsed before the two events were regarded in connection with each other.

---

[1] Aphr., I. p. 343: "Unum tamen inter cætera dico, morbum hunc contagiosum esse: unde iterum atque iterum moneo, ne cum mulieribus hac perniciosa ægritudine laborantibus, aut eae cum viris hac ægritudine infectis, se commiscerint." To this effect also *J. de Vigo*, 1503. Aphr., I. p. 450.

[2] *Nic. Leonicenus*, l. c.

The earliest contribution of any physician, in reference to this point, was made by Leonhard Schmaus, professor in Salzburg, who, in 1518,[1] wrote: "Compertum est jam omnibus, occidentales Indos, per plurimos annos hoc morbo graviter laborasse." It appears, therefore (as is also evident from the letter of Jo. Manardus,[2] written in 1525), that this view was already widely entertained at the time, although not one of the early medical writers mentions it; and even Schmaus is disposed to regard the origin of the disease in Europe as due to the influence of weather. R. Diaz de Isla, whose writings, although not printed till 1539,[3] were probably written some time earlier (about 1510), claims to have treated men from the ships of Columbus, who were suffering from the disease before they landed; and also that he had persons under treatment for the same affection in Barcelona, before the King of France had come into Italy.

In Barcelona the disease is said to have spread from the soldiers and sailors of Columbus, they having brought it with them from Hispaniola (Hayti); and that it was raging there as early as the middle of the year 1494, is shown by a letter of Nicolaus Scyllatius[4] that was written on the 18th of June, 1494. But it is very remarkable that Scyllatius makes no mention of an American origin of the pest that he found in Barcelona, while he expressly states that the physicians had informed him that the disease had been imported from France.

Diaz de Isla advances as an especial ground for believing that the disease had long existed in Hayti, the elaborate treatment in vogue there, more particularly in the use of the guaiacum wood. "How could these uncultivated people have attained to such a systematic method of treatment unless the disease had been prevalent among them for a long time?" Indeed it seems chiefly to have been the introduction of the guaiacum wood into Europe—into Spain in 1508, and into Italy in 1517 (Delicado)—that gave currency to the theory of the American origin.

Columbus arrived in Barcelona in the middle of April, 1493, after having landed at Seville in the first part of the same month. But inasmuch as before this he had remained nine days at Lisbon, and was for some time detained by stormy weather off the Azores, and furthermore, since one of his ships before joining him at Palos, south of Seville, had touched at the coast of Galicia, it was naturally suggested that, supposing the disease to have been really brought from the West Indies, it should have broken out in all these places before it did in Barcelona. Montejo endeavors to show that this was impossible, since but a few of Columbus' men landed at the Azores, and remained only for a short time, and that they were cruising there in the storm but one week altogether; and at Lisbon, he declares, the crew did not go ashore, and Columbus himself, accompanied only by a pilot visited the King of Portugal, not in Lisbon, but at a country-seat in Valparaiso. In reference to Seville, Montejo shows that there was a hospital there as early as 1502, for the treatment of syphilis, which was then called "Scrampion de las Indias." [1]

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[1] Aphrod., I. p. 383. [2] Aphrod., I. p. 606. [3] Med. Times and Gaz., 1867, II. p. 90.
[4] *Friedberg*, l. c., p. 116.

From Spain the disease was carried into Italy, partly by Spaniards in the army of Charles VIII. and partly by the Spanish army which was led by Gonzalo Hernandez de Cordova into Italy to the assistance of King Ferdinand II. of Naples, and landed at Messina in May, 1495.

The contribution that did most to circulate the theory of the American origin of the disease was the work of Gonzalo Hernandez de Oviedo,[2] who, in 1513, was sent out to Hayti to inspect the mines there, and in 1525 published a description of the country. We find this theory oftener mentioned or avowed by the medical writers of the middle of the sixteenth century, as, for example, by Alfonso Ferro (1537), J. Bapt. Montanus (1550), A. Musa Brassavolus (1551), Gabr. Fallopia (1564). Astruc's[3] celebrated work lent the theory weight in the eighteenth century, but at the same time, instigated the critical writings of Ant. N. R. Sanchez,[4] and Hensler,[5] which, in spite of the partially well-founded objections raised against them by Girtanner, have still had the effect of depriving Oviedo's statements, with regard to the primary occurrence of syphilis in the West Indies, of all credit, even to the present day. Only recently has an effort been made by Montejo, Gaskoin, and Bassereau to re-establish them. The latter urges that during the life of Oviedo no opposition was raised to his view, although, in other respects, his history of the West Indies encountered no little hostility. But, after all, that does not appear so remarkable when we consider that this view was an explanation of the outbreak of the disease (to every one a new and strange affection) which obviated all difficulties, and that the Spaniards, and especially the French, were only glad to accept a theory that relieved them from the reproach of having themselves given birth to the disease. However, Oviedo's assertion did encounter an adversary even in the sixteenth century, in the already-mentioned Spanish priest, Francesco Delicado,[1] who lived for a long time in Italy, and who makes the statement that the disease (with which he was acquainted from sad personal experience) prevailed as early as 1488 in Rapallo,[2] and was conveyed to America by Columbus' men.

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[1] Med. Times and Gazette, l. c.

[2] Relacion sumaria de la historia general y natural de las Indias occidentales. Toleti, 1525. In the editions of Ramusio and Barcia it is stated that the disease came from India; on the other hand, in a transcript of the above passages that the Spanish monk, Francesco Delicado, introduced into his work on guaiacum, it reads that the disease was very common amongst the Indians. Moreover, this transcript from the Relacion, which is probably the oldest in existence, differs essentially in other respects from both the later ones, so that it seems as though alterations had been made in Oviedo's work, that is, that the whole history of the American origin of the disease had been fabricated.—*S. C. H. Fuchs:* F. Delicado, über den Guajak; *Janus*, Centralmagazin, etc. Gotha, 1853. S. 193.—La historia general y natural de las Indias occid. Sevilla, 1535.

[3] *Joannes Astruc*, l. c.

[4] Dissertation sur l'origine de la mal. vénér. Paris, 1752. Examen historique sur l'apparition, etc. Lisbonne, 1774. Vide *Girtanner*.

[5] *Ph. G. Hensler*, l. c., and Ueber den westindischen Ursprung der Lustseuche. Hamburg, 1789.

Certain other alleged facts, in regard to the first outbreak of the disease, which were used as objections to Oviedo, prove not to be authentic, as shown by recent investigations. Thus, the accuracy of the date of the frequently quoted letter of Petrus Martyr Anglerius to Arius Lusitanus, in Salamanca, was indeed suspected by Sanchez, to whom this letter might have been of material service, and it has recently been called in question by Pellicier, Muñoz, and Cantù.[3] This letter is dated April 15, 1488, and commences: "In peculiarem te nostræ tempestatis morbum qui appelatione Hispana Bubarum dicitur (ab Italis morbus Gallicus, medicorum Elephantiam alii, alii aliter appellant) incidisse præcipitem, libero ad me scribis pede." Against the statement made by Gaspar Torella,[4] viz. : "Malignam hanc ægritudinem incepisse anno 1493, in Alvergnia et sic per viam contagionis pervenisse in Hispaniam," etc., Bassereau[5] contends that in the chronicles of Puy, which were written by a contemporary and citizen of the town, De Meyès, it is particularly mentioned that the "vérole" first showed itself in that city in the year 1496.

There is no doubt, therefore, after what has been said, that the disease was in existence in Spain before the campaign of

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[1] *Delicado*, Il modo di adoperare legno di India occidentale salutifero remedio, etc. Venetiis. 1529. vid. *Janus*, Centralmagazin, etc. Bd. II. 1853. S. 193.

[2] *J. de Vigo*, who was born in Rapallo, and wrote in 1503, does not mention this, and makes the first outbreak of the disease occur in 1494.

[3] *Gaskoin*, l. c., p. 201. G. observes that Hallam (History of European Literature) also regards the chronology of the letter of Petrus Martyr as unreliable.

[4] Aphrod., I. p. 494.

[5] L. c., p. 21

Charles VIII. But there is in the dates thus far presented nothing inconsistent with the supposition of its importation from America. Nevertheless, there are a number of descriptions and historical notices extant, which make it probable that the disease was not unknown in certain portions of Europe, even prior to the first return of Columbus from the West Indies; indeed, the terms "morbus gallicus," and "mala franzos" are met with in some chronicles before the Neapolitan campaign of Charles VIII.

Friedberg (p. 90–93) cites the cases of various persons of high rank, who were affected by a disease, the description of which is a very fair representation of syphilis; as, for instance, the case of the bishop of Posen, Nicolaus von Kurnik, who died the 18th of March, 1382, after having suffered first from ulcers of the genitals and afterwards of the tongue and throat, so that he was hardly able either to speak or to swallow, and finally with ulcers upon the right side (latus quoque dextrum per scissuras penitus fuisse ruptum).

Of far less value than these descriptions of the disease, as it seems to me, are certain citations from the older chronicles which occur in such an isolated manner that one cannot refrain from doubting their authenticity. Thus Friedberg cites a passage from the Annales Danicæ of the year 1483: "morbus gallicus sævit super Christianos" (p. 95). Again, from the Chronisten des Saalkreises: "Anno 1493, um diese Zeit hat sich zuerst die schädliche Seuche des morbi gallici oder sogenannten, s. v. frantzosen in diesen Landen eräugnet" (p. 98). In the Stiftsprotokoll of St. Victor zu Mainz, of the year 1472, it is recorded that a chorister besought leave of absence, in order that he might undergo treatment for the "mala franzos" (p. 95).

All things considered the probability is that syphilis existed in certain portions of Europe, more especially in Southern Europe, prior to the epidemic outbreak of the disease in Italy at the end of the fifteenth century, in the same way, perhaps, as it yet prevails in certain retired localities in the form of an endemic disease (vid. p. 18). But at the end of the fifteenth century various circumstances combined to favor a great general, epidemic outbreak. The previous centuries, by means of the crusades and the peculiar pilgrimages of the fourteenth century, had already set the people in motion, and established more intimate relations between the different nations. The unsettled mode of life had tended to deprave the morals, and the rough bands of soldiers roving through the country gave occasion to all kinds of licentiousness. In Italy, just before the outbreak of the morbus gallicus, an epidemic disease, probably of typhous character, had been raging and destroyed many people, the affection having been imported with the Jews (Marranen),[1] who were driven out of Spain; besides, the years 1494–5 were marked by great rain-falls, so that floods occurred at Rome and other places. All these circumstances, added to the pernicious meteorological and hygienic influences that always accompany war and siege, would naturally impart to the already existing disease an acuter, severer character than it had before; just as we now observe worse forms of the disease in persons reduced in health, or living under unfavorable hygienic conditions.

The campaign of Charles VIII. also contributed largely to the spread of the disease in Italy, Spain, France, and Germany. This spread during the last ten years of the fifteenth century was extremely rapid and general.

As early as 1496 measures were taken in the different cities of France and Germany to put a stop to the extension of the pest. On the 6th of March, 1496,[2] the Parisian Senate issued a decree designed to protect the inhabitants from the epidemic; it began with the statement that a certain contagious disease, "la grosse vérole" had been raging violently in different parts of the kingdom for two years. In Nuremberg[3] the Rath passed an ordinance concerning the bath-keepers, and in reference to the "new" disease of the "French." In Frankfort, according to J. Rohrbach, a cotemporary, the disease broke out in the summer or spring of 1496. On the 9th of August of that year the Rath decided to issue a proclamation to the people, and on the 13th and 25th of October passed decrees[4] with regard to it. The monk, J. Sciphover de Meppis,[5] relates of this pest (pestis miseranda et lugubris), existing in the principality of Osnabrück and in Westphalia, that the disease came from Bremen and Hamburg.

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[1] These unhappy fugitives were also made responsible for the dissemination of syphilis. Compare *Hirsch.*—Jo Nauclerus, a cotemporary, states in regard to the pest that broke out with the arrival of the Jews in Italy, that it destroyed many people, the morbus gallicus but few (nonnullos), "plerosque inutiles fecit." Cited by *Bassereau*, p. 39.

[2] *Astruc*, l. c., p. 75. According to our calendar, 1497.

[3] *Waldau*, Vermischte Beiträge zur Geschichte der Stadt Nürnberg, B. IV. p. 409.

[4] *G. L. Kriegk*, Deutsches Bürgerthum im Mittelalter.

[5] Chronic, archicomit. Oldenburg. in Meibom. script. t. II., 1497. Cited by *Gruner*, l. c., p. 116.

Medical writings on the subject first appeared in Germany in 1496–7.[1]

The question as to whether syphilis towards the end of the fifteenth century was really a *new disease*, or was then for the first time imported into Europe, has engaged the attention of physicians with greater earnestness the farther they have been removed from that period. To the cotemporaries, the influence of the stars, war, famine, and flood sufficed to account for the production of a new disease. Others contented themselves with the theory of the American, or even of an Ethiopean (Bapt. Fulgosius) origin. Still, even at that time, there were some who sought to trace a connection between it and diseases with which they were already familiar. They were especially disposed to trace the source of syphilis to lepra—the leprosy—which was at that time becoming extinct. But the efforts to identify these two diseases were opposed by Nicolaus Leonicenus (1497).[2] On the other hand, again, Natalis Montesaurus[3] (1498) declared that the disease was no new one, but had already been described under the names Bothor and Asaphati; and Sebastianus Aquilanus[4] (1498) says that it is identical with the elephantiasis of Galen; but, in this, is sharply corrected by Jacobus Cataneus[5] (1516). An attempt has been made recently to establish the theory of the development of syphilis from leprosy. A. F. Simon calls it the offspring of the leprosy, and claims, too, that under certain circumstances it may become its parent.[6] What we see of leprosy in the East and various other lands at the present day, certainly bears but slight resemblance to syphilis; and it is noticeable, too, that in the commencement of the sixteenth century, the lepers were evidently afraid of infection from those who were syphilitic (leprosi nolebant habitare cum hoc morbo infectis, says Laur. Phrisius, Aphr., I. p. 344), and that this was no groundless fear, that is, that lepra afforded no immunity against syphilis, is shown conclusively by the inoculation tests of Danielssen. Still it is not impossible, or even improbable, that the term "lepra" was made to embrace much that properly belonged to other diseases, syphilis included; and this view is made plausible by E. Güntz[1] from the descriptions given of lepra by B. Gordonius (1305). So far as we know, the leprosy is not contagious, and therefore such passages as the following of J. Gaddesden[2] have an especial significance: "Ille qui concubuit cum muliere cum qua coivit leprosus puncturas inter carnem et corium (scil. virgæ) sentit et aliquando calefactiones in toto corporo et postea frigus et insomnietates et circa faciem quasi formicas currentes;" and comparing such passages with others where lepra is not directly referred to, but rather some general infection of the body following impure sexual intercourse, the unavoidable conclusion is that the implied disease is syphilis. The same is true of the statement of Gérard de Berry, who lived in the thirteenth century, to which E. Littré[3] makes reference: "Virga patitur a coitu cum mulieribus immundis de spermate corrupto vel ex humore venenoso in collo matricis recepto: nam virga inficitur et aliquando alterat totum corpus."

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[1] *Joseph Grünbeck*, Tractat. de pestilentiali scorra sive mala de frantzos, etc. (Vid. Girtanner.)

Johannes Widmann, professor in Tübingen, Tract. de pustulis et morbo, qui vulgato nomine mal de Franzos appellatur. (Vid. Astruc, p. 429.)

The first French medical writer upon syphilis was *Jaques de Béthancourt*, of Rouen: Nova pœnitentialis Quadragesima necnon purgatorium in morbum gallicum, etc. Paris, 1527. (Astruc, p. 450.)

[2] Aphr., I. p. 18.

[3] Aphr., I. p. 115.

[4] Aphr., I. p. 5, seq.

[5] Aphr., I. p. 143.

[6] Virchow's Handbuch der spec. Pathol. und Therapie, II., 1, p. 429, and l. c.

If we go still further back in the literature, the question becomes more involved, from the fact that in the writers of antiquity and of the middle ages we rarely find such minute and descriptive accounts of morbid appearances as are contained in certain passages from Celsus and Oribasius;[4] but the accounts are mostly limited to descriptions of various local affections, for which technical names are employed, whose import, expressed according to modern pathological views, is not easy to determine. The position of pathology, or of any single prominent investigator at any period, has a decided influence upon the interpretation of such expressions. We only need compare the historical researches concerning syphilis for the last twenty-five years to be convinced that the construction which is placed upon these technical expressions varies essentially according as the investigator advocates the doctrine of unity or duality in syphilis.

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[1] Archiv für Dermatologie und Syphilis, B. II., 1870, p. 59.

[2] Rosa Anglica, lib. II. cap. 7, de lepra, cited by *F. W. Müller*, l. c., p. 113.

[3] *Janus*, Zeitschr. f. Geschichte u. Lit. d. Med., von *Dr. A. W. E. Th. Henschel*, B. I., 1846, p. 594. E. Bassereau (l. c., p. 12) says indeed that Littré has declared this passage of Gérard, whom Bassereau calls G. de Nevers, to be apocryphal, but does not tell where Littré has made this statement.

[4] Vid. the excerpts on condyloma and aphthæ, by *F. W. Müller*, p. 37–42, and p. 89.

For those who made syphilis arise from the most various local affections of the genitals, from gonorrhœa even, the fact of there being evidence that such local affections had been observed and unmistakably described in remote antiquity was quite sufficient proof of the existence of syphilis in those times; while, on the other hand, certain adherents of dualism saw only in these records descriptions of purely local affections, such as are of frequent occurrence at the present day, and have, in common with syphilis, solely their frequent source in unclean sexual congress.

It is striking that in the writers of Grecian and Roman antiquity, and in early mediæval times, we find no accounts of such affections as occur in children with hereditary syphilis. A passage in Michael Scotus, de procreatione et hominis physiognomia, which Cazenave[1] cites, may possibly have some reference to this: "Sciendum est quod si erat fluxus quando erat facta conceptio creatura concipitur vitiata in plus aut minus." In the Ajurvéda of the Indian medical writer Suśrutas,[2] which contains throughout, very interesting accounts of affections that owe their origin to sexual intercourse—and can, therefore, scarcely be considered as anything else than syphilis—there occurs a passage, which also may refer to hereditary syphilis; he mentions an "atrophia ulceribus terribilis" of infants which is ascribed to the influence of demons.

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[1] *Cazenave*, l. c., p. 24.

[2] *Suśrutas*, Ajurvéda. Translated into Latin by Dr. F. Hessler. Erlangen, 1844–50, B. I., cap. XII. and XIII., p. 195, and cap. II. p. 175; II. p. 124. Vid. also *Friedberg*, p. 33. *F. W. Müller*, p. 14–19. Regarding the age of the writings attributed to Suśrutas, see *Haeser*, p. 17. As the latest period of their production may be taken the eighth century of the Christian era.

It is therefore in the highest degree probable, though difficult absolutely to prove, that, not only local affections of the most varied description, due to unclean sexual connections, but also syphilis existed even in antiquity, both in the East and in Europe. But it was not recognized as a special form of disease, as a disease *sui generis*, until the close of the fifteenth century.

It is a noticeable fact that, originally, various exclusively local affections of the genitals—ulcers (caries, caroli) and discharges (gonorrhœa)—were distinguished from the "morbus gallicus" and were represented as something peculiar. And there was considerable doubt, with regard to the epidemic outbreak of the disease, as to whether its origin was not due to the action of general causes. Gradually, however, as the most frequent source of the disease came to be recognized, all affections of the genitals springing from sexual intercourse were included in common under *morbus gallicus.*

As early as the sixteenth century infection was recognized as the cause of a blennorrhœa of the urethra, while it had been hitherto regarded as a true gonorrhœa, as a *superfluitas.* In the earliest descriptions of morbus gallicus no mention is made of the gonorrhœa, and even in the petition (published by Beckett[1]) of Simon Fish to Henry VIII., in the year 1530, the clap was distinguished from other diseases communicable through coitus, as appears from the following extract: ". . . that catch pockes of one woman and bear them to another; that be burnt[2] with one woman and bear it to another, that catch the lepry of one woman and bear it to another . . ."

Although still at the end of the sixteenth century Hieronymus Capivaccius (1590)[3] speaks of a "gonorrhœa citra luem veneream," we find that such a distinction was more and more lost sight of, up to the end of the seventeenth century; so that Sydenham[4] wrote: "cujus (scil. morbi) virus cum per gonorrhœam non ejiciatur, sanguinis massam dicto citius pervadit inficitque."

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[1] Cited by *Friedberg*, p. 72.

[2] The French synonym "chaude-pisse" occurs in the thirteenth century (*E. Littré*, James I., p. 595) while "burning" appears in a decree as early as 1162 (*Friedberg*, p. 71).

[3] *Hieronymi Capivaccii*, Acad. Patav. professoris, de lue venerea acroasis. Spiræ, 1590.

[4] *Thom. Sydenham*, Op. universa. Epis. respons., II. Lugd. Batav., 1726, p. 328.

But in the second half of the eighteenth century voices arose in England, demanding the separation again of gonorrhœa and syphilis, as two distinct diseases. In 1767, Balfour[1] in a dissertation upon the subject, maintained their non-identity. But this view produced a less general impression than it would otherwise have done, since so weighty an authority as John Hunter,[2] supported by experiments, decided in 1787 in favor of the identity of gonorrhœa, chancre, and lues venerea. In May, 1767, Hunter had inoculated (probably upon himself) pus, which he considered to be gonorrhœal matter, on the surface of the glans penis and prepuce.[3] Ulcers were produced, followed after some months by ulceration of the tonsils, and a coppery skin-eruption. Consequently it appeared to Hunter that the identity of the gonorrhœal, chancrous, and syphilitic virus had been clearly demonstrated. Differences in the manifestations he believed to depend solely upon the difference in locality; on mucous membranes the venereal virus produced a blennorrhœa, upon the skin an ulcer. On the other hand, Benj. Bell[4] took up the controversy in 1793, and advocated (likewise supported by experiments) the view of Balfour. But the matter was only settled definitively, in consequence of the numerous inoculations made by Ricord,[5] in the year 1831. Out of many hundred inoculations of the skin with gonorrhœal secretion, Ricord did not succeed in producing a chancre or constitutional syphilis in a single instance; the contrary results obtained by others he explained by supposing that in their cases a chancre had been concealed within the urethra. Thus gonorrhœa was finally once more eliminated from the definition of syphilis, and the latter term was limited to ulceration and certain other disease-processes upon the genitals, and to those symptoms called, since

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[1] *F. Balfour*, diss. de gonorrhœa virulenta. Edinburgh, 1767. Cited by *P. H. Watson*, The Modern Pathology and Treatment of Venereal Diseases. Edinburgh Med. Journal, 1860 and 1861.

[2] The works of *John Hunter*, ed. by J. F. Palmer, Vol. II. London, 1835, p. 143.

[3] L. c., p. 417.

[4] *Benjamin Bell*, Treatise on Gonorrhœa Virulenta and Lues Venerea. Cit. by *P. H. Watson*. See also *Auspitz*, das syphil. contagium. Wien, 1866, 52 f.

[5] *Ricord*, traité pratique des maladies vénériennes. Paris, 1838. *Auspitz*, l. c., p. 61.

Hunter's time, "constitutional." A further restriction of the term was proposed by Bassereau in 1852, in separating from syphilis the so-called soft chancres and the suppurating buboes, to which they often give rise. Concerning this point, which is still regarded in many quarters as not yet settled, we shall come to speak later more at length.

Returning once more to the first epidemic outbreak of the disease at the end of the fifteenth century with which we started, it remains to be observed that the character of the disease, originally so malignant as to occasion universal alarm, before long grew milder. Even during the second decennium of the sixteenth century the course of the disease had become much less severe, other symptoms than those seen at first gradually became prominent[1], and by the middle of the sixteenth century we find various physicians (Hieronymus Fracastorius and Anton. Musa Brassavolus amongst others[2]) expressing the opinion that the disease would continue to grow milder, and finally become extinct. To be sure this hope has not yet been realized, but the fact of there having been indications which appeared to justify it then, leave us to conclude that the disease in the first half of the sixteenth century manifested much the same forms and course as at the present day.

But even now we occasionally see a repetition upon a small scale of this early epidemic outbreak, with the virulence of the disease at the commencement and its subsequent gradual moderation, in instances where syphilis has suddenly invaded localities previously exempt. Such instances have been occasionally observed, in late years, in consequence of the sudden invasion of certain regions by troops and seamen. Where the conditions are particularly unfavorable and the locality retired, the first outbreak of syphilis is apt to show a remarkable intensity; but after the more virulent forms of the disease have become extinct, a certain hereditary taint is often left behind which manifests itself amongst the later generations in the form of manifold chronic affections, these latter receiving the name generally of the locality where they made their first appearance. Endemic diseases of this class, remnants of former violent outbreaks of syphilis, are seen in the *Radesyge* in Sweden and Norway, the *Jutland Syphiloid*, the *Ditmarsch disease* of Holstein, the *Sibbens* of Scotland, the *Skerljevo* of the Illyrian coast, and others[1]. A closer study of these forms of disease throws no little light upon the general history of syphilis itself, since many interesting facts regarding the latter recur within circumscribed limits in these diseases, and can, therefore, be more conveniently studied; such facts, for example, as the novel and startling character of the original outbreak; the naming of the disease from its locality or from that of its presumptive origin (usually from the nation whence it was imported); after long continued prevalence of the disease, the habit of including under the same name the most diverse affections, especially those of the skin; when widespread, and, as often happens, when propagated in other ways than by sexual intercourse, the inclination to search for other modes of origin than that by contagion. Of the abovementioned diseases the *Radesyge* and *Skerljevo* have been the most carefully studied, and these (excluding various common skin diseases which were also embraced under these terms, as scabies, eczema, psoriasis, lupus, and in Norway the leprosy (spedalskhed)) have been shown by the Norwegian physicians Boeck and Danielssen, as well as by Hebra and von Sigmund, to consist really in acquired or hereditary syphilis, which has often become inveterate and been neglected.

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[1] The historian *Francesco* Guicciardini says in Della Istoria d'Italia, lib. II.: "At length after many years the disease became milder and different from what it had been at first." Cited in *Girtanner*, B. II. S. 932.

[2] *Astruc*, p. 71, cites a number of passages which refer to this subject.

How widespread these diseases may become, is seen in the case of the skerljevo, with which, according to medical statistics in the year 1800, out of 39,000 inhabitants of the Hungarian seaboard, there were 6,000 affected severely and 8,000 slightly[2]. Furthermore, in the skerljevo we see how rapid an abatement of the disease may be brought about by judicious measures and the appropriate anti-syphilitic treatment[1]. At the the present time all of these diseases are in the course of extinction.

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[1] *Hirsch*, S. 364 f. *Zeissl*, S. 299. *Lancereaux*, p. 25 s.

[2] *Cambieri*, Omodei Annali univ. di medicina. Zeissl, S. 299.

GEOGRAPHICAL DISTRIBUTION OF SYPHILIS.

In consequence of the active intercourse which has been maintained between different countries in modern times we may say that at the present day syphilis is prevalent throughout the world. Its principal seats are the great centres of traffic and luxury, whence the disease is continually being conveyed to other and remote parts. Especially is this true of the great seaport towns. In many countries the coast is invaded before the regions inland. The fact that syphilis develops less readily in one place than another is to be ascribed solely to external circumstances. The mode of life, manners, and customs, material prosperity, national temperament and the grade of civilization are the main points that influence the spread of syphilis. Race appears to have no particular bearing upon susceptibility to the syphilitic poison. It is, therefore, so much the more remarkable that in certain countries, although exposed to the infection, the disease has yet made no progress. These countries are Iceland and, according to Livingstone, a portion of Central Africa. Livingstone states that the natives who had contracted the disease upon the West coast recovered, on returning home, without medication. This peculiarity however was exhibited only by natives of pure African blood; mixed breeds were affected by the disease precisely as Europeans, and, moreover, negro tribes of other regions did not enjoy the same immunity[2].

The causes which have hitherto prevented syphilis from taking root in Iceland are still quite obscure; and, moreover, Livingstone's statements require confirmation.

According to the testimony of various informers, the disease appears to be more severe when communicated to Europeans from persons of another race. Armand alludes to this in regard to Europeans infected in China. But in this connection other circumstances besides difference of race come into account, as acclimatization, etc.

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[1] *Zeissl*, l. c.

[2] *Hirsch*, l. c., S. 372.

Time would not permit to cite all the countries where syphilis is especially prevalent, or to relate what is known concerning the period of the earliest occurrence of the disease in the various lands. In this connection we would refer to the exhaustive treatise of Hirsch. We will only allude to the facts that in the South Sea Islands the disease threatens to exterminate the natives, and that in South America, but still more so in Mexico, it is extraordinarily prevalent. At the end of the previous century the spread of the disease in America had been very limited, and there are said to be to this day certain Indian tribes, living quite apart by themselves, whom the disease has never reached. In the East its principal seats are the great seaport towns of China and Japan; in Africa, Egypt, Abyssinia, and Algiers, and also the western coast; in Europe, the northern provinces of Turkey, the northern portion of European and Asiatic Russia.

So far as the influence of climate upon the development and course of syphilis is concerned, it constitutes a factor of but secondary moment in comparison with the other outward influences which affect health and vitality. According to Lagneau,[1] the course of the disease owes its character to the temperature of the region where it occurs. In the warmer countries it is claimed that it runs a more rapid course than in the colder. In regard to the influence of climate upon the severity of the disease, a number of statistics, intended to indicate a favorable influence of mild climates, are offset by Hirsch with another series, equally large, which shows that even with the most favorable climate the disease may take a very malignant course. The more uniform the climate is, the less unfavorable will the influence be from this particular source; but at the same time the resulting advantage may be quite outweighed by other circumstances. Residence in a region with an excellent climate, but one to which the individual is unacclimated, may produce the same result as though the climate were subject to the extrèmest variations of temperature.

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[1] *G. Lagneau*, Rech. compar. sur les mal. vénér. dans les diff. contrées. Annal. d'hygiène publique et de méd. légale, Ser. II. t. XXVIII. Cited by *Zeissl*, S. 12.

GENERAL CONSIDERATIONS REGARDING THE COURSE OF SYPHILIS.

Before proceeding further we would call attention to the general features of syphilis as they display themselves in the ordinary course of the disease. After the virus has been inoculated, whether by direct contact of some local lesion, secreting the poison, with an abraded surface of skin or mucous membrane, or by being carried underneath the epidermis by means of a lancet, a period of several weeks elapses usually before anything further is to be observed. In artificial inoculations a circumscribed redness of the part may appear, which will occasionally develop into a little pustule; this, however, dries up in a few days, and in a short time everything disappears. As a rule, no changes will be observed before the lapse of three weeks. Then a little red papule makes its appearance, which slowly increases in elevation and circumference, and after a few days may be felt by the finger as a distinct induration. The redness and hardness of this papule are quite sharply defined from the surrounding parts. The papule is termed the "*primary lesion*" of syphilis, or, on account of its hardness, the "*induration*" or "*initial sclerosis*."

A few days later than the first appearance of these changes at the point of inoculation, it is observed that the lymphatic glands, in whose district the infected part lies, are the seat of a slowly increasing swelling; only one gland is affected at first, but afterwards several. These swollen glands feel likewise strikingly hard to the touch, are not tender, are freely movable underneath the skin, and are known as *indolent buboes.*

While now the induration at the point of inoculation increases, there usually appears upon its surface a little scaliness, or a thin crust is formed, which being removed displays a shining surface of a bright red color, exuding a scanty secretion. If the formation of the crust be prevented by a moist dressing, a thin, gray, diphtheritic-like deposit is formed over the secreting spot. Other forms of the primary lesion will be described elsewhere under their appropriate head.

Meantime, while the induration and glandular swellings increase, the patient begins gradually to grow pale, to feel indisposed, and in the course of from six to eight weeks from the commencement of the local manifestations, or nine to eleven from the infection, with or without febrile symptoms, *an eruption* breaks out upon the skin, without itching, in the form of red spots or papules. Simultaneously with this, or usually somewhat later, an inflammation begins in the throat, at first simply catarrhal, but shortly leading in its further course to ulceration or to the production of circumscribed flat growths upon themucous membrane.

With the access of these general symptoms it is customary to say that the syphilis has become "*constitutional.*"

A simple macular skin eruption is usually of short duration, but flat papules often make their appearance, springing from the maculæ, or else appearing from the very commencement, and these, under certain circumstances, may remain from two to three months, meantime often undergoing various transformations. More obstinate still than the papular skin eruptions are the *flat condylomata* of the fauces and larynx, about the angles of the mouth, the anus, or the female genitals. These are generally present at the same time with the eruptions of the skin, and are essentially papules of the mucous membrane, due to changes similar to those of the skin, but modified by the locality.

These may persist for months, ulcerating and manifesting, during the first eight or ten months after infection, a great disposition to recur, even in spite of proper treatment, and after the external integument has long returned to its normal condition. Simultaneously with these affections of the skin and mucous membranes, there is often more or less alopecia, occasionally affections of the nails, and very frequently a periostitis arises somewhere with exquisite tenderness on pressure, together with violent pains, especially at night. In addition to these, the *eye* is often affected within the first six months from infection, in the form of an iritis or inflammatory process affecting the deeper tissues of the organ, particularly the *retina.*

Enlargement of the lymphatic glands belongs to the most invariable changes of this period. They are similar to those found in the neighborhood of the point of infection, and occur in the most various situations. Of those accessible to the touch the cervical and cubital glands are the most commonly affected.

Now the disease taking a favorable course, all these signs begin to subside, and in not a few cases, especially where the proper treatment has been pursued, in ten or twelve months from the infection the previous health is restored, the patients recover their former aspect, and in some the disease is at an end. But in the majority of cases new crops of eruption come and go upon the skin and mucous membranes, as small papules on the tongue or isolated patches of psoriasis upon the palms of the hands, which often preserve a purely local character, the general condition being thereby not at all affected. But sometimes these manifestations occur more extensively, and are accompanied by general symptoms.

As a rule, syphilis exhibits a great diversity as regards the *intensity* of its attacks, which to a large degree is determined by individual peculiarities. Although in a large number of cases we see the disease following the course which we have depicted above, in certain patients of naturally feeble constitution, or else debilitated by excesses or deprivations, *suppurating eruptions of the skin*—pustules—sometimes develop, which become encrusted and are converted into ulcers, that gradually increase in size and finally heal by cicatrization. They may occur at an early stage of the disease, occasionally at the first general attack, but more commonly as a consecutive symptom ; they are often accompanied with violent fever, sometimes with chills. Severe ulceration takes place in the throat in these cases, and is marked by a rapid destruction of tissue. In the nasal cavities the bones are denuded in places by the ulcerative process, and necrosed portions are expelled, followed by a sinking-in of the contour of the nose, with permanent disfigurement. The pains in the bones, already alluded to, are particularly severe in these cases, and associated with marked swellings. But in these cases, too, the symptoms subside after a while, and the course of the disease is temporarily arrested.

This period of *latency* has an exceedingly variable duration, and ensues upon manifestations, more or less severe, in cases of the most varied intensity, after the first eight or ten months from the infection. Now, symptoms appear again, perhaps so long deferred that the former attack, particularly if it was a light one, has long been forgotten. It is only during the last ten years that these later symptoms have been regarded as syphilitic, and referred to their proper source. And even at the present time, in spite of our more extended knowledge of the disease, the true nature of many of these manifestations is too often misapprehended. A part of them have mainly the character of purely *local affections*, as those relapses, for instance, spoken of above; but, on the other hand, some of them present themselves under the form of a general affection, of a deep-seated *marasmus*, often accompanied by *hectic fever*.

The *local affections* are peculiar, on account of a marked tendency to tumor development not usually shown by the earlier manifestations of syphilis, and the growths to which this gives rise do not exhibit that disposition to undergo resorption which is characteristic of the inflammatory symptoms of the previous stages of the disease, but a tendency rather to disintegration and necrosis. These growths, which, as we now know, may occur in any organ, were described by the earliest observers of syphilis as occurring in the bones and skin, or subcutaneous cellular tissue. They present, at first, hard elevations, afterwards gradually softening, and are termed, on account of their gummy-like, semi-fluid, grayish-yellow contents, "*gummy tumors*," or "*gummata*." In the skin, mucous membrane, subcutaneous cellular tissue and periosteum, the softening and discharge of the gummata is usually in the direction of the external surface; but in the internal organs the periphery of the tumor becomes thickened into a fibrous envelope of connective tissúe, enclosing the contents of the original gumma, which have now become condensed, fatty-degenerated, and dry.

The disintegration of the gummy tumor of the subcutaneous cellular tissue and skin is attended with *ulcerative processes*, which show a marked tendency to constantly involve fresh portions of skin, gradually invading the surrounding integument in *serpiginous ulcers*, which cicatrize at one extremity while the destructive action extends at the other. If such ulcers are situated over bone, or if the gumma have proceeded originally from the periosteum, caries and necrosis take place.

The *internal organs* which are most commonly attacked by gummy tumors are the liver, the testicles, and the brain, with its membranes. The gummata proceed from the connective tissue, and especially from the adventitia of blood-vessels; they not infrequently occasion grave symptoms, particularly when occurring in the brain. The symptoms produced by gummata are of great variety, depending upon the importance of the organ implicated, and the seat and extent of the tumor.

Beside these local processes, in numerous cases, though by no means in all, a high grade of *marasmus* takes place, with marked pallor and great emaciation, and often, especially in affections of the bones, accompanied with *fever of a decided, remittent type.* Though local manifestations upon the skin are absent in these cases, there are usually present tumefactions of the bones and joints, and the case may present many of the features of an acute articular rheumatism. Or, in case there be a cough and other signs of bronchial catarrh, a suspicion of pulmonary phthisis might easily be awakened, particularly on account of the hectic fever that is present. In not a few of these cases there is also albuminuria, with or without dropsy, due to amyloid degeneration of the kidneys.

At length the patients succumb either to anasarca, sometimes with dysenteric affections, or to uræmia, or caseous pneumonia, unless beforehand some syphilitic local process, implicating an important organ, as the brain or heart, puts a speedier termination to life.

The main points in the course of the disease which we have just sketched may be recapitulated as follows:

1. The *infection.*
2. The *local affection.*
3. The *acute general affection*, the period of whose manifestations lasts for six or eight months, and is then followed either by a termination of the disease, or,
4. By a period of *latency* having a variable duration, and passing into
5. The period of *gummous formations* and ulceration.
6. *Syphilitic marasmus.*

THE STAGES OF SYPHILIS.

Suggestions with regard to a division of the course of syphilis occur in the writers of the sixteenth century. Thus De Vigo[1] (1503) contrasts the Lues gallica *recens* with the Lues gallica *confirmata.* Thierry de Héry[2] (1552) divides the symptoms into the *antecedent* (local), viz., ulcers of the genitals, clap, buboes; *the consecutive* (*suivants*), viz., skin eruptions, affections of the mucous membrane, alopecia, wandering pains, and *the subsequent* (*survenants*), viz., the fixed pains with bony elevations and caries or necrosis, ulcers of the skin, marasmus—a division that contains the nucleus of some of the later divisions, particularly that of Ricord.

Ricord distinguishes

1. A *primary period*, comprising the development of the local process of infection and the indolent glandular swellings;

2. A *secondary period*, which includes those early affections that depend upon the general infection, and are superficially situated, involving skin and mucous membrane, and comprising alopecia, disease of the nails, iritis, and affections of the testicles.

Up to the year 1859, R. represented it as a radical mark of distinction between the secondary and primary periods that the secondary manifestations were no longer contagious, and that the disease could only be communicated in this stage by inheritance. Subsequently, however, in consequence of the numerous convincing inoculations with the secretion from "secondary" syphilitic affections, Ricord was compelled to abandon this position.

3. A *tertiary period*, the symptoms of which, besides occurring late in the course of the disease, are severer in their manifestations, for the reason that deeper tissues (the subcutaneous and submucous tissues, bones and joints, together with the visceral organs) are implicated, chiefly in the form of gummata. The disease in this stage is not transmissible by inheritance, but may very likely give origin to scrofula and rachitis in the succeeding generations.

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[1] Aphrod., I. p. 450.

[2] La méthode curatoire de la maladie vénérienne, etc. Paris, 1552, p. 133. Cited by *Fournier*, Leçons sur la Syphilis. Paris, 1873, p. 308.

This division of the course of syphilis, while having regard mainly to certain relations of time, has also in view the location of the several derangements, and corresponds in general with the clinical features of the disease. But Cazenave, in 1843, objected to such a division, even from a clinical point of view, contending that any consecutive manifestation of syphilis may, without exception, appear at any time, whether more or less distant from the period of infection, and one may precede the other indifferently.[1] As soon as the different derangements are thoroughly investigated in their pathological anatomy, it becomes manifest that so sharp a division as that of Ricord is neither correct chronologically nor anatomically admissible. Virchow[2] has shown that both mild and severe symptoms, or what Von Bärensprung represents as the critical events (*Kriterien*) of the secondary and tertiary periods—simple hyperæmias and exudations on the one hand, and tubercular formations on the other—can occur together in all stages of syphilis and that in hereditary syphilis especially, the manifestations of Ricord's secondary period may be in progress while, simultaneously, the most pronounced changes of the tertiary period are taking place in the viscera. Indeed, Virchow goes still further, for while admitting that the gummy tumors possess a certain specific character, not only as regards their histological structure, but in respect to the course they pursue, as distinguished from the purely irritative processes, he also insists upon the histological resemblance between the initial sclerosis and the gummy tumors, and hence, in a measure, brings the beginning and end of syphilis into immediate relation with each other.

While we cannot but acknowledge the justice of the objections urged to the divisions of Ricord on the score of the pathological anatomy, it is still not to be denied that from the standpoint of clinical observation, such a statement of the case as Ricord has made is exceedingly attractive, and, relieved of its manifest inaccuracies, may be found yet of practical value.

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[1] L. c., p. 471. Compare also p. 317 and 207.

[2] Ueber die Natur der constitutionell syphilitischen Affectionen. Arch. f. path. Anat., B. XV., 1858, S. 217.

First of all, it is to be borne in mind that so sharp a chronological division as that of Ricord does not in reality exist; that there are cases of acquired syphilis whose course is so extremely rapid and severe that those profounder derangements of tissue, which usually only appear during the later course of syphilis, are developed in the very first months following the infection. In the great majority of cases such a sequence in the symptoms is preserved that, during the early months, or even years, of the disease only irritative changes of a light character (adhesive inflammations) manifest themselves, not, as Ricord would have it, on the surface of the body only, but in all the organs and tissues, and later the gummous and destructive processes begin. Hence, according as the type of the lesion is more strongly marked in the one than in the other, we may distinguish two stages—the *condylomatous* and the *gummous*, as Zeissl[1] and others, have done. Finally, there exists in regard to the action of therapeutic measures a great difference between the manifestations of the secondary and tertiary periods, as admitted by Virchow.[2] The facility with which the manifestations of Ricord's tertiary period yield to the iodide of potassium is wholly disproportionate to the effect of this remedy upon the manifestations of the secondary period, for the cure of which latter it is almost inert; and again, while mercury in the secondary period acts very promptly, in cases of the tertiary class it occasionally exerts an actually pernicious effect. In England the opinion of the most experienced syphilographers is quite unanimous upon this point. I will only mention J. Hutchinson, who says:[3] "The marvellous power of the iodide of potassium in the cure of these affections (the tertiary) is universally admitted, and has led to the almost entire disuse of mercury in their treatment." Hutchinson also points out some of the differences between the symptoms of syphilis in the secondary and tertiary stages, upon which not enough stress has been hitherto laid, viz., the symmetry manifested by the secondary symptoms (the skin eruptions, ulcers of the tonsils, iritis, and retinitis), in contrast to the marked asymmetry of the tertiary symptoms, which often occur in quite isolated forms; further, the disposition of the secondary affections to heal spontaneously, while the tertiary have a progressive and destructive character. Besides, he alludes to the protection afforded against new syphilitic contagion being less in the tertiary period, while the probability of not transmitting the disease to the offspring is greater. Between the second and the well-characterized third stages there may be an intermediate stage of latency or relapses, of uncertain and often very prolonged duration. The relapsing affections of the skin during this intermediate period are neither so abundant nor so symmetrical as in the secondary.

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[1] L. c., S. 80.

[2] L. c., S. 218.

[3] L. c., p. 311.

The *marasmus* that persons who have had syphilis sometimes exhibit has often nothing at all directly to do with this disease. It is generally dependent upon such changes as may gradually take place from other causes, particularly from long protracted suppurations. Under this head belong the amyloid degenerations of the large abdominal organs and of the lymphatic glands. These marasmatic conditions may be regarded as sequelæ of syphilis, or, with Von Sigmund, as a fourth period of the disease.

Comparing syphilis with other infectious diseases, particularly the exanthemata, we find the secondary period of syphilis to be the equivalent of what we are accustomed to regard as the disease proper in these affections, that is, it is the direct expression of the general blood-poisoning. Again, the tertiary period of syphilis corresponds to the sequelæ of the acute exanthemata, which are the result of the previous action of the poison upon the tissues. During the secondary period of syphilis we may consider that all the tissues are subjected uniformly to the action of the poison, the vehicle of which at this time is the blood, as shown by experimental inoculations. But we must also bear in mind that not only the organism as a whole, in different cases, but also different tissues of one and the same organism react differently when acted upon by the poison; in other words, that evidences of irritation are more easily provoked in one tissue than another. Now gradually the poison is eliminated, but the tissues that have been temporarily under its influence, or that were formed while its activity continued, though outwardly exhibiting no morbid appearances, have in reality undergone a permanent change, which on the one hand renders them insusceptible to fresh syphilitic contagion, and on the other leaves them more disposed to inflammatory affections. These inflammatory affections, by virtue of the peculiar quality imparted to the tissues by the syphilitic poison, pursue a peculiar course and thereby acquire, in a measure, a specific character (gummata). It is often necessary to the inception of such inflammatory processes that there should have been first an external shock, an occasioning cause, as an injury, an exposure to cold, an intercurrent disease, or some powerful emotional disturbance. This predisposition, which is generated by the syphilitic poison, need not appertain equally to the entire body in all its parts. From the especially intense action of the poison upon some particular organ or tissue, the predisposition may manifest itself there earlier than in others; thus in one organ a gummy tumor may be developed, while elsewhere evidences of the direct operation of the syphilitic virus still remain, as happens occasionally in very severe cases and in hereditary syphilis.

A similar view was taken of the sequence in the manifestations of syphilis by Cazenave.[1] Through the primitive symptoms (under which he includes the primary local affection and the acute manifestations of the secondary period (in the ordinary sense) another "individuality" was impressed upon the person affected, a latent condition developed that is no longer dependent upon the presence of the virus in the system, and is first brought to notice through accidental external causes in the form of morbid symptoms. These symptoms are termed secondary by Cazenave, but under them he includes much that evidently belongs to the acute blood-poisoning.

Therefore we believe that a practical division of the symptoms of syphilis would be to separate them into groups according to the order in which they gradually develop. Hence we distinguish

1. *The primary stage*, beginning with the infection and comprising the gradual development of the local symptoms at the point of infection and the indolent gland swellings in the

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[1] L. c., pp. 177, 207, 483.

vicinity. This stage therefore includes the three or four weeks of incubation, and is terminated at the breaking out of general symptoms.

No absolute immunity from new infection with the syphilitic poison.

2. *The secondary stage.*—Blood-poisoning at its height. Begins six or eight weeks from the first appearance of the primary affection; accompanied frequently by an eruptive fever.

As a rule, *superficial* eruptions of skin and mucous membrane, distributed symmetrically over both halves of the body. Falling of the hair and disease of the nails. Often anæmia. Lymphadenitis universalis. Simple irritative processes in the periosteum and interstitial cellular tissue of internal organs. Disposition to heal spontaneously without loss of tissue, though under certain circumstances leading to permanent derangements of function, through adhesions of connective tissue or contractions.

In exceptional cases (mainly due to a feeble constitution or one that has been debilitated by accidental external influences) the more profound tissue derangements occur even in this stage, bearing the same character which commonly distinguishes the appearances of the subsequent stage.

Immunity from new infection with the syphilitic poison. Transmission of the disease to offspring.

Duration of this stage from several months to a year. It merges, without definite boundary, into an intermediate stage of very uncertain duration, during which the disease remains quite latent, or from time to time various eruptions appear upon the skin and mucous membranes, which are usually more limited in extent, less symmetrical, and not so acute as the first general manifestations of the secondary period. The continuance of the blood-poisoning in this intermediate period, though in diminished and with steadily decreasing intensity, is still evident in the immunity from new infection, and in the very great likelihood of transmitting the disease to offspring.

In these condary and intermediate stages the influence of a *mercurial course* is decidedly favorable.

3. *The tertiary stage*, characterized by local affections, for the most part *asymmetrical*, often occasioned by external causes, and consisting in cell-growths, having a tendency either to disintegrate or to become encysted with caseous metamorphosis and new formation of connective tissue. Gummata of the various organs, ulceration, necrosis, and caries of skin and bone. General state of nutrition usually, though not always, bad.

Markedly favorable effect of the *iodide of potassium*. Effect of mercury often unfavorable.

Since this stage is affected by all that has preceded it, by accidental external influences, and also particularly by the constitution of the patient, its limits as to time are necessarily uncertain. In the exceptional cases which have been already alluded to, it may even begin but a few months after the infection, and be therefore concurrent with the secondary period. But, as a rule, several years—often twenty or more—intervene between the time of contagion and the outbreak of tertiary symptoms.

The blood-poisoning proper of syphilis is now either insignificant or entirely absent, so that offspring generated in this stage usually escape infection. The local manifestations, also, of this period are incapable of conveying the syphilitic virus, and *immunity* from new infection with the disease is *diminished*.

This stage is either concurrent with or merges into

4. *The stage of confirmed syphilitic marasmus*, or, more correctly speaking, marasmus induced in consequence of syphilis. Irremediable changes, as amyloid degeneration, destructive caseous pneumonias, dysenteric and other ulcerative processes.

The two last-named stages are considered by S. Wilks[1] and J. Hutchinson as *sequelæ* of syphilis.

The variations with respect to the *form* and *severity* of the course pursued by syphilis, which a large series of cases present, are very remarkable. They may be so great as to produce the impression of quite distinct diseases. In general, the various forms may be divided into the *mild* and *severe*. The character of the latter has been already indicated.

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[1] Guy's Hospital Reports, Ser. III., Vol. 9, p. 13.

The source of these variations in the form of the disease might possibly lie in differences in the original *virus* (in respect to quantity and quality), as claimed by Carmichael, of Dublin (1815), who maintained that there were four different sorts of virus, together with four different sets of primary and consecutive manifestations of the disease. Or they may also lie in *individual peculiarities* of the infected person, as is often the case in other infectious diseases. Of a number of persons exposed simultaneously to the infectious poison of measles, scarlatina, or small-pox, that is, to a poison of the same kind and intensity, some will not be affected at all, others only slightly, and some very seriously. So it is with syphilis. Frequently enough, the peculiarities of constitution which determine a severe course are quite obvious. It is in individuals who are scrofulous, liable to inflammations, debilitated through deprivations or excesses, or else naturally strong but living under peculiar climatic or other outward conditions which are unfavorable—sailors, for example—that we observe the severer forms of the disease which are often well pronounced, even in the early stages, as in the cases of phagedæna.

GENERAL PATHOLOGICAL ANATOMY.

Lebert, Robin, Verneuil, Bullet. de la Soc. anatomique, 1855.—*Lebert,* Handb. d. prakt. Medicin, 1 Aufl., 1859, B. I., S. 370.—*Virchow,* Ueber. d. Natur der constit.-syphil. Affectionen. Arch. f. An. u. Phys., B. XV. S. 217.—*A. van Oordt,* Des tumeurs gommeuses. Thèse de Paris, 1859.—*Gros* et *Lancereux,* Des affections nerveuses syphilitiques. Paris, 1861, p. 150.—*E. Wagner,* Das Syphilom. Arch. d. Heilkunde, B. IV., 1863, S. 1; B. VII., 1866, S. 518.—*Virchow,* Die krankhaft. Geschwülste, B. II. S. 387.—*Cornil* et *Ranvier,* Man. d'histol. pathol. Paris, 1869, V. I. p. 186.—*E. Rindfleisch,* Lehrbuch der path. Gewebelehre, 3 Aufl. Leipzig, 1873, S. 92.

The changes which the syphilitic infection induces in the humors of the body, particularly in the blood, are but little known. The investigations of Ricord and Grassi,[1] who found a diminution in the red corpuscles and an increase in the albumen of the serum, have really only proved the existence of what, in many instances, is apparent to the naked eye, viz., oligæmia. Besides, the fact is pointed out by Virchow, that when numerous lymphatic glands suffer hyperplasia, in consequence of the irritation of this poison, there is a more abundant production of white blood-corpuscles, that is, there is often produced a certain degree of leucocythosis. Hence these changes are by no means either essential to or characteristic of syphilis. No more can any organized components of the blood be shown to be characteristic of syphilis, as the researches of Lostorfer (to which we shall again refer later) seemed at first to promise.

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[1] Bullet. de Thérapeut., 1844. *Ricord.* Leçons sur le chancre. *Lancereaux,* l. c., p. 96.

The *local manifestations* of the action of the syphilitic poison upon the tissues at the point of infection, as well as in other parts of the body, have been repeatedly and thoroughly investigated. Various sets of changes are found, *post-mortem*, in syphilitic subjects, but only a portion of the changes have any direct connection with the syphilitic infection ; cellular infiltrations, fatty degeneration and atrophy of the tissues, and, finally, amyloid degeneration of various organs, are the most essential of them. Only the cellular infiltrations are properly characteristic of syphilis ; these constitute the distinctive feature which the most diverse local manifestations of the disease possess in common, and the connective tissue is the matrix in which the cellular growths develop. The cells composing them have generally a single large nucleus, and bear a very close resemblance to the white blood-corpuscles, to the cells of lymphoma, and to those of the cell-growths in typhus. According as we accept the position of Cohnheim, or adhere to the older views, shall we regard the point of departure for these cell-accumulations to be in the blood-vessels or in the connective tissue. Virchow compares the entire formation to granulation tissue. From the fact of the close resemblance of the cells which pervade the tissues, or occur in the form of young tissue-growths, with the white blood-corpuscles, is it evident that, however much they may characterize syphilitic new formations, they wholly lack specific microscopic characters. Still, their arrangement and the development and further course of the cell-growths afford certain marks by means of which it is possible perhaps to distinguish the syphilitic new growth from every other. This is asserted by E. Wagner, and he has, therefore, adopted the special name "*Syphiloma.*"

The most peculiar and striking of the local affections due to syphilis is the *gummy tumor*, and it is to this especially that Wagner has applied the above term.

Gabriel Fallopia has pointed out very clearly the main characters of gummy tumors, giving at the same time an explanation of their name, in the following passage:[1] "Isti tumores cum contineant materiam crassam, quæ est veluti gummi eliquatum, ideo gummata Gallica vocantur a medicis." He proceeds to describe the hard tumores tophacei and continues as follows: "Secunda species tumorum est quando materia est mollis, quæ tripliciter apparet, nam aliquando est veluti lardum, aliquando est minus crassa et est similis polentæ et est atheroma Gallicum: tertia species est sicut mel et dicitur meliceris Gallica."

Tumors of this sort, varying in consistency, may develop in any organ in consequence of syphilis; but their favorite seats are the subcutaneous cellular tissue, the skin, in and upon the bones, the liver, the testicles, the brain, the kidneys, and, especially in children, the lungs. According to Wagner's description, they present the appearance of a grayish-red, soft, homogeneous mass, either without fluid contents or else yielding a scanty juice like mucus. They may occur as infiltrations of microscopic size, scattered throughout the parenchyma of an organ, and even when they appear as sizable tumors, as large as a walnut or more, they are not encysted nor sharply defined, but merge directly into the surrounding tissue. In fact, sometimes they occur more in the form of a diffuse infiltration than of a distinct tumor. Now, the development progressing, a softening takes place in the central portions, a metamorphosis into the above gummous or honey-like substance, or, on the other hand, the mass becomes drier and firmer, showing on section in certain places more than others, a yellow color and cheesy consistency.

Microscopically a fresh syphiloma shows nucleated cells of the character mentioned above, more or less closely packed together, and so imbedded in the tissue that when the cells are brushed away little cavities remain in their places. Here and there, beside the round cells, spindle-shaped cells may be seen occasionally, an indication of commencing transformation into connective tissue. The central softening is effected either through a simple atrophy and fatty degeneration, or through a mucous metamorphosis, under which circumstances, according to Rindfleisch, stellate branching cells are often formed. Such a gumma, then, presents the appearance of a nodule, with more or less fluid contents, enclosed in a dense cortical layer. After a certain period fibrous tissue begins to be formed in the peripheral layers of the nodule, owing to the fact, probably, that nutrition is more active in these portions. This new connective tissue surrounding the growth develops most rapidly after the central portions of the tumor, or several isolated spots, have become caseous, in consequence of fatty degeneration of the densely crowded cells and of their intervening tissue; the yellow spots then appear scattered throughout an exceedingly dense structure.

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[1] Tractat. de morb. Gall. (1564), Aphrod., II., p. 826.

It is in the last-named form, which represents its final stage of development, and in which it may continue to remain for many years, that the gumma is most commonly found in the internal organs. The parenchyma of the latter, in consequence of the displacement, compression, and the cicatricial contractions to which the organs are subjected, suffers various alterations. The effects of a gummy tumor may extend to a great distance, in case it has caused contraction of the calibre of some vessel, especially of a blood-vessel, which is particularly liable to occur when the tumor has its seat in the adventitia of a vessel. Fatty degeneration and wide-spread processes of softening may be the consequences of a tumor in itself insignificant, as occasionally happens in the brain.

When situated in the skin, in the subcutaneous cellular tissue, upon mucous membranes and superficial bones, the gumma often makes its way to the surface, since in these situations it is not uniformly enclosed upon all sides, but is exposed to an unequal pressure. The entire infiltration then ulcerates.

That which especially characterizes the gummy tumor is the general course of development which the new-formed tissue pursues; for there is nothing that is specific in the separate processes of this development. Virchow points out as a special characteristic the perishable nature of the cells, their disposition to become disintegrated through an incomplete fatty metamorphosis. But the cells of the gummy tumor share this nature with those of numerous other new growths, notably with tubercle. The resemblance of a cheesy gumma to cheesy tubercle, in certain parts of the body, may be so great that it becomes difficult to distinguish the one from the other. Even Wagner, who, in regard to the specific character of "syphiloma" goes much farther than Virchow, does not look for its specific character in its histological constitution at any particular period of its development exclusively, but takes into account the mode of its course, the etiology, and even the action of remedies upon the development and further course of the tumor, to assist in characterizing it. The histology, therefore, furnishes scarcely any more certain points for diagnosticating a new grówth to be syphilitic than may be obtained from a circumspect clinical examination of the case, together with a thorough investigation of its history.

Still, we may believe with Wagner that the cells of the syphilitic new growths have in reality a more specific character than is apparent. The whole course of their development points to such being the fact; they owe this specific character to the tissues—the soil in which they develop—and so, indirectly, to that indefinable action of the syphilis poison upon the tissues, whereby those properties are imparted to the cells which determine their future destiny. These properties have undoubtedly something specific about them; but their specificness is not obvious with regard to the single cell, and can only be inferred from the course pursued in the cellular growths.

The close histological relationship between the gumma tissue and the primary affection to which Virchow has called attention, and which we have already alluded to above, consists solely in the *cellular infiltration* that occurs in both, and is, in fine, no more remarkable than we meet with elsewhere subsisting between widely diverse pathological conditions. Many of the local processes of the secondary period also present precisely the same histological characters. But what distinguishes these processes from the gummy tumors is their tendency to wholly disappear by resorption, or else to form more highly organized tissue; that is, to develop connective tissue, bone tissue, etc. The specific character of these secondary processes, then, must lie in something different from that of the later events. So Virchow makes the distinction between the merely *irritative* and the *gummous processes.* The primary affection, in our opinion, is to be ascribed to the former, for the reason that in a large proportion of cases it is a process which disappears in a comparatively short space of time without leaving a vestige of it behind. The source of the irritation to which it is due, viz., the syphilis poison, is in this instance brought from without directly into healthy tissue; during the irritative processes of the secondary period the virus operates from within, *i.e.*, from the blood, upon all the various tissues of the body. But the tissues react under it at first still as in a normal state. During the period of gummous development it is probably no longer the action of the specific poison upon normal tissue with which we have to do, but with a sort of specific reaction of tissues, modified by previous blood-poisoning, under some accidental irritation.

SPECIAL CONSIDERATIONS.

ETIOLOGY.

THE SYPHILITIC POISON.

H. Auspitz, Die Lehren vom syph. Contagium. Wien, 1866.—Concerning *Lostorfer's* investigations, vid. Archiv f. Dermatol. u. Syph., IV., 1872, p. 115 f. Schmidt's Jahrbücher, B. 154, S. 170. *Zeissl*, l. c., S. 32.

Our knowledge of the contagious principle of syphilis has been thus far limited to its effects. Neither as a chemically definable substance nor as a definitely formed body has it been possible yet to isolate it.

That some kind of *contagious principle* lies at the bottom of the disease was evident to unprejudiced observers even at the time of the first outbreak of the morbus gallicus. The view that arose in consequence of its pestilential spread, viz., that a miasm, originating outside the body, pervaded the atmosphere, did not long maintain its ground. The very manner in which the propagation of the disease through the medium of the air was spoken of by the physicians[1] of that day, shows that the assertion was made oftentimes not wholly in earnest. J. Fernelius[2] expresses himself in the clearest manner concerning the syphilitic poison, in comparing infection with it to the bite of a mad dog or the sting of a scorpion, and he also points out the fact that the fluids of the body serve as a vehicle for the poison.

When Liebig compared the nutritive changes caused by animal poisons with fermentative processes, great stress was laid upon the *chemical* nature of the poisons to which the infectious diseases were due, and these poisons were held to be analogous to the ferments, to the nitrogenous substances. But now, since it has been shown, chiefly by Pasteur, that the presence of minute organisms—fungi and bacteria—are necessary to the production of many of the so-called fermentative processes, similar living *organisms* have been sought for as causes of the infectious diseases. The investigations of Salisbury concerning the cause of malarial fever, and of Hallier in regard to cholera, led the way to further researches in reference to other infectious diseases, and it was not long before there was discovered not only a cholera fungus, but a fungus for measles, for scarlatina, and even for gonorrhœa and syphilis. Salisbury and Hallier have cultivated and described all these fungi. But these discoveries, unfortunately, could not be confirmed by others. Nevertheless, both these investigators have earned the merit of opening up a new field for research, and while no very decisive results have thus far been achieved, we have at least gained the advantage of regarding the subject from some new points of view.

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[1] The Spanish physician, *J. Almenar*, writes (1502): ". . . æris corruptio, per quam causam evenisse, pie credendum est in religiosis." And further below: "Satis est ut scias hunc morbum esse contagiosum." Aphrod., I. p. 361.

[2] Aphrod., I. pp. 610, 614.

The idea of living organisms—minute forms of life in active motion—being the essential cause of syphilis, as, according to Athanasius Kircher (1659), they were of the pest, was expressed in a rough form as early as the seventeenth century.[1]

It was shown with regard to the vaccine lymph by Chauveau and Burdon Sanderson, that the contagious element did not reside in the fluid portion, but in minute, roundish, microscopic bodies that strongly refracted the light. Similar little bodies were discovered by Lostorfer in the blood of syphilitic subjects. Examinations of the blood, extending over several days, resulted in the discovery of small, strongly refracting corpuscles, which made their first appearance on the third or fourth day, and rapidly increased in size during the days following. This discovery excited all the more interest, since Lostorfer, according to report, was able to select correctly from among a number of specimens of blood given him those which came from syphilitic persons.

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[1] Compare *Astruc*, l. c., p. 91; *Cazenave*, l. c., p. 67.

But the importance attached to Lostorfer's researches was attacked by Wedl and Köbner, and it was not long before these corpuscles were deprived of all claim to a specific character, through the fact being proved that like bodies occur in normal blood, and that they probably originate in the white blood-corpuscles, which, in certain stages of syphilis, are often increased.

Since, then, the syphilitic poison can be isolated by means of neither chemical nor anatomical tests, we come, in the next place, to inquire *in what constituents of an organism infected with syphilis this poison resides, and, in general, what are the relations which it bears to this organism or towards one not infected.*

The question whether the syphilitic poison, that is, *whether syphilis may be transmitted to the lower animals*, has been the subject of numerous experiments. The attempts made to inoculate animals with the pus of chancre, by Auzias Turenne and others,[1] have determined nothing. The famous ape from which Dr. von Welz inoculated himself, had been previously inoculated with the pus of a simple contagious pustule developed in a syphilitic person, that is, from chancrous pus, and had afterwards a chancre only and no syphilis. But a like result, namely, the production of simple contagious ulcers, has also, in numerous experiments with animals, followed inoculation of secretions from true syphilitic local affections.

Only three cases, so far as I know, are on record where syphilis has been actually communicated by inoculation to animals. Two of these were reported by S. Messenger Bradley.[2] He had previously made numerous attempts at inoculation, which had been either quite fruitless or resulted only in the production of soft sores. The cases were communicated to the surgical section, at the annual meeting of the British Medical Association in 1871. "In two cases (a guinea-pig and a young kitten) the inoculation was followed, in from two to three weeks, by a local thickening at the point of inoculation, and afterwards by constitutional syphilis. The guinea-pig died within one month from the commencement of the induration, with destruction of one eye, and extensive ulceration of the mouth and soft palate. I killed the kitten at the end of the eighth week, and found syphilitic gummata in the kidneys and liver."

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[1] *Auspitz*, l. c., p. 293.

[2] British Medical Journal, 1871, Sept. 30, p. 376.

In a third case, Ch. Legros[1] produced an indurated ulcer in a guinea-pig by inserting a bit of a syphilitic induration underneath the skin of the leg. During cicatrization of the wound the animal commenced to grow marasmic. It died five and a half months after the inoculation, and at the autopsy there were found extensive swellings of the lymphatic glands, enlargement of the liver, with cicatrices upon its surface, and little cellular tumors in its substance, besides a number of gummy-like nodules in the deeper layers of the cutis, and a firm yellow nodule the size of a pea in one epididymis, an illustration of which is given in Lancereaux. Lancereaux, however, in view of the marked predisposition of guinea-pigs to irritative connective-tissue growths, expresses doubt as to the syphilitic nature of this affection. Zeissl[2] made some experiments with syphilitic blood, with which he inoculated rabbits and doves, but with a negative result.

VEHICLES OF THE SYPHILITIC POISON.

1. It has long been a recognized fact that the primary affection of syphilis, the ulcerating sclerosis, bears the syphilitic poison; that whether by contact in sexual intercourse, or by other mode of contiguity, as well as in experimental inoculations, this poison can be communicated to a healthy person from the primary affection.

2. For a time there was less concurrence of opinion with regard to the infectious nature of the local manifestations belonging to constitutional syphilis. After the opinion expressed by Hunter,[3] based upon both theoretical and experimental grounds, viz., that neither the local manifestations of constitutional syphilis nor the blood and secretions of syphilitic persons are conta-

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[1] *Lancereaux*, l. c., p. 597.

[2] *Lancereaux*, l. c., p. 42.

[3] L. c., p. 383 and 384.

gious, had apparently been confirmed by Ricord in more complete experiments, it doubtless seemed as though the question had been settled definitely in the negative. In his Lettres sur la Syphilis, 1850 and 1851,[1] Ricord makes the following statement: "The primary ulcer, in the period of its extension, is the only source of the syphilitic poison."

As early as 1830–40 experiments in inoculation had been made which yielded quite a different result—a result which was more consonant with the numberless clinical experiences that had been made ever since physicians first began to make syphilis a study. These experiences had attributed to the flat condylomata especially, properties eminently contagious.[2] These experiments differed from those of Hunter and Ricord in that instead of inoculating the secretions from local affections in persons with constitutional syphilis upon the bearers of these affections, or upon persons already syphilitic, the inoculations were made upon such as had been previously healthy. Wallace, of Dublin, in 1835, was the first to make inoculations of this sort.[3]

From a series of experiments communicated by Wallace we select the following as the most instructive: On the 15th of November, 1835, W. inoculated both thighs of a healthy man with the contents of syphilitic pustules that had first appeared upon a patient fourteen days before. The places healed with scars. In the second week in December there appeared at all of the points of inoculation upon the right thigh, and in two of those on the left, little, elevated, brownish-red papules with desquamating surface. Some of these papules turned into ulcers, which were covered with greenish-yellow scabs, and remained till the 11th of January, 1836. At the same time there were enlargements of the lymphatic glands in both inguinal regions. On the 21st of January general manifestations appeared, with a measly eruption and redness of the isthmus of the fauces.

Wallace also alludes to several successful inoculations with the secretion from flat condylomata, communicated to him by some person not named. But the communicability of syphilis through these local forms of the disease was more forcibly illustrated by cases of Waller,[1] in Prague, and therefore we proceed to his experiments.

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[1] Union médicale, Eighteenth Letter.

[2] In spite of the Ricord terrorism, some held firmly to this view, even in France, (*Baumès* (1840), *Cazenave* (1843), l. c., p. 176.)

[3] The Lancet, 1835 and 1836.

On the 6th of August, 1851, a boy by the name of Durst was scarified upon the skin of the front part of the right thigh, with a clean instrument, and pus from flat condylomata in a female patient was smeared over the part, partly by means of a spatule and partly with a bit of charpie that had been dipped in the pus, and the latter was then bound upon the wounds. On the next day there were evidences of slight inflammation, which, four days later, had entirely disappeared. On the 15th of August several red spots made their appearance at the place that had been scarified, from which by the 30th of August (*i.e.*, twenty-five days from the inoculation) fourteen tubercles, as large as peas, had developed in the skin, most of them springing directly from the scars caused by the scarifications. They were hard to the touch, partly of a dirty red color, others of a dirty yellow, some of them desquamating. During the succeeding days they became confluent, and had then the appearance of a nodular place, the size of a silver half-dollar, covered with scales. September 27th (twenty-seven days after the appearance of the tubercles, and fifty-two days from the inoculation) a macular exanthem appeared upon the skin of the abdomen, chest, and back, which during the following days extended and grew more abundant, without evidence of fever. In the early part of October certain of the maculæ were changed into papules, others into tubercles, in short, into the characteristic appearances of a syphilide. There had been no throat affection at the time the case was reported.

Amongst others an anonymous physician of the Palatinate[2] (1856), Gibert[3] (1859), Guyenot of Lyons,[4] von Bärensprung[5] (1859), von Hübbenet[6] (1859), Lindwurm[7] (1860–1), Hebra and Rosner[8] (1851 to 1862) have successfully inoculated persons previously healthy with syphilitic virus contained in the secretion of condylomata lata.

Thus by experiment was demonstrated what practice had already taught in hundreds of cases. Ricord, in order to account for the above observed facts, and not be inconsistent with his own former statement, that only the primary lesion can communicate syphilis, was obliged to resort to the most forced assumptions. Under the above class of inoculations belong the frequent infection of nurses through suckling infants, transmission of the disease in kissing, etc.—indeed, it may be asserted *that the condylomata lata are the most common source of syphilitic contagion.*

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[1] Praeger Vierteljahrschrift, B. 29, 1851.

[2] Aerztl. Intelligenzblatt, 1856, No. 35.

[3] Bulletin de l'Académie de Médecine, t. 24, p. 881.

[4] Gaz. hebdom., 1859, No. 15.

[5] Annalen des Charitékrankenhauses. Berlin, 1860, B. IX., S. 110–208.

[6] *C. von Hübbenet*, Die Beobachtung und das Experiment in der Syphilis. Leipzig, 1859.

[7] Würzburger medicin. Zeitschrift, 1862, Bd. III., S. 146.

[8] *Auspitz*, l. c., p. 225.

An experimental inoculation has also been made with the secretion from a constitutional affection of the tonsils, and was performed by Dr. Lindemann upon himself.[1]

In a friend of his, seven days after the breaking out of a syphilitic skin eruption, a deep ulcer had appeared upon either tonsil. On the twenty-second day after the first appearance of these tonsillar ulcers, Dr. L., having carefully cleaned the left tonsil two hours before, inoculated himself, by means of a new lancet, with the scarcely purulent secretion that had meantime again accumulated, in the skin of his left forearm. On the eleventh day following, a rose-colored, hardish papule, about the size of a pin's head, without areola, made its appearance. It increased in size and became covered with a crust, beneath which a reddish fluid collected. In a short time the ulcerated papule developed into a characteristic indurated chancre, and three months later there appeared a papular syphilide and swelling of the cervical glands.

Von Rinecker,[2] of Würzburg, inoculated a young physician, Dr. R. W., who had never had syphilis, with matter from *acne pustules* in a child forty-nine days old, which was affected with hereditary syphilis, on the 5th of January, 1852.

By means of a blister a bleb was raised upon the forearm of the physician, and to the portion of skin thus deprived of its epidermis the pus from the acne pustules was applied. Jan. 10, the part had healed. Jan. 15, desquamation and redness of the inoculated place. The skin felt tough and infiltrated throughout its thickness, especially at the edges, and mostly at the lower and inner angle of the rectangular space corresponding to the portion of skin that had been inoculated, and to just that portion of it where the most matter was deposited. Just at this point were several rather resistant papular elevations, varying in size from a lentil to a pea. By the 10th of February the entire inoculated space was occupied by brownish-red, tough-feeling tubercles, and on Feb. 15, some of these were covered with scabs, underneath which suppuration was going on. Under the influence of hydrarg. biniod. and chloride of zinc paste this local affection disappeared with cicatrization.

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[1] Bulletin de l'Académie de Médecine, Jan. 21, 1852.

[2] Verhandlungen der phys. med. Gessellschaft in Würzburg, B. III., 1852, S. 391.

June 12 (159 days after inoculation) there was malaise, and eight days later the tonsils and front part of the velum palati were found dotted with red spots, which afterwards ulcerated superficially, with the production of a grayish-white exudation; later, upon the scrotum, red, infiltrated, moist, and superficial fissures.

With the *blood* of persons suffering from constitutional syphilis experiments have also been made, which in some instances have yielded decisive results. The first experiment of this sort was made by Waller.

The person experimented upon was a boy fifteen years of age, who was suffering from lupus exfoliativus of the cheek, but had never had syphilis. The skin of the left thigh was scarified with a new instrument, and blood, taken by means of a cupping-glass from a patient with constitutional syphilis, was applied to the scarifications, partly with a splinter of wood and partly by dipping a bit of charpie in the blood, and then binding the latter upon the wounds (July 27, 1851). The wounds healed, but after thirty-four days (Aug. 31) W. noticed at the point of inoculation two distinct tubercles as large as peas. They increased in size during the days following, became confluent at their bases, and were surrounded by a red areola. The subjacent cutis, together with the subcutaneous connective tissue, was dense and indurated, and ulceration commenced upon the surface of the tubercles, which were covered by a thin, brown crust. October 1 (sixty-five days after the inoculation, and thirty-two days from the first appearance of the tubercles) an exanthem appeared upon the skin of the abdomen, chest, back, and thighs, which, during the subsequent days, extended over the entire body. Meantime the point of inoculation had become an ulcer as large as a half-dollar, with a gray base and coppery-red border.

The anonymous physician of the Palatinate, mentioned above, applied the blood of a patient with constitutional syphilis to ulcers of the leg, in six cases, and thereby caused infection in three of them, without any special changes at the point of inoculation, but followed by the development of exanthems and lesions in the throat. In three other cases, which were inoculated with blood taken from one of the persons who had been infected in the above manner, the result was negative. On the other hand, the following case reported by Gibert[1] may, perhaps, be regarded as a positive success in the inoculation of syphilitic blood, although the latter was mingled with some intercellular fluid, and, it may be, with some organized elements from a syphilitic efflorescence:

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[1] *Auspitz*, l. c., p. 190.

A patient at the Hôpital du Midi, with a cicatrized indurated chancre on the outer surface of the foreskin, and flat condylomata about the anus, had, upon the forehead, a coppery, scaly, perfectly dry papule of the size of a ten-cent piece. On the 9th of February, the border of this papule was pricked with the point of a lancet, and the latter having been thus moistened with a little serous blood, was immediately introduced into the skin of the front of the forearm in a person affected with lupus faciei. In fourteen days every trace of the puncture had disappeared, and the patient was discharged. Much surprise was occasioned when the patient re-entered the hospital upon the 1st of April, showing at the point of inoculation a reddish papule, which he said had appeared there fourteen days before. Above and around this spot there were observed several somewhat elevated, coppery-red spots, the beginning of a consecutive squamous syphilide, which extended afterwards over the whole body. In the corresponding axilla a tender glandular enlargement had developed larger than a hazel-nut.

Von Lindwurm injected blood from a person with constitutional syphilis, by means of a Pravaz' syringe, underneath the skin between the shoulder-blades, in a woman seventy-one years old, who was suffering from a cancroid affection of the skin of the forehead, with necrosis and exfoliation of the frontal bone. In the fourth week after the injection was made, a small red papule was formed at the site of the puncture, and increased in size, becoming covered with a thin, yellowish-brown scab. It reached the size of a gold dollar, was surrounded by a red areola, elevated at its edges, excavated in the centre, and rested upon a hard base, and upon removal of the scab showed a red, somewhat spongy surface, covered by a thin secretion that quickly dried into another scab. Eight days after, there appeared, two inches above the ulcer, between the spine and border of the scapula, just beneath the cutis, an enlarged lymphatic gland the size of a bean.

Subsequently the occipital, cervical, and cubital glands became also enlarged, and a macular, papular, and squamous syphilide appeared upon the skin.

The most recent inoculations with syphilitic blood were made by Pellizzari,[1] of Florence (1862).

He had already twice made the attempt before, but without success. On the 6th of February, 1862, he repeated it upon three physicians, who voluntarily submitted themselves to the experiment. The blood was taken by venesection from a woman, twenty-five years old, with constitutional syphilis, who was in her sixth month of pregnancy. The arm had been carefully washed beforehand, and at the point selected there were no manifestations of syphilis. The instruments employed were all new. As the blood flowed from the vein a brush of charpie was dipped into it and applied directly to the left arm of Dr. Bargioni at a point near the insertion of the deltoid, where the epidermis had been previously removed, and three transverse incisions made.

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[1] Gazette hebdom., 1862, No. 22.—*Lancereaux*, l. c., p. 477.

The two other physicians, Drs. Rossi and Passigli, were inoculated in a similar manner in the forearms, but the blood had then become cold and coagulated. The inoculation was successful only in the case of Dr. Bargioni. On the third day every trace of the local injury had disappeared; on the twentieth day a papule appeared, which for nine days remained dry, then became moist and began to ulcerate. An enlargement of the axillary glands preceded the ulceration.

From the 4th to the 12th of April nocturnal headache; general roseola and swelling of the glands in the nape of the neck.

At first Ricord maintained an attitude of defence with regard to the results of these experiments; with brilliant logic, though his objections were often trivial, he sought to invalidate the evidence of Wallace, Waller, and others. It was not until the year 1859, after the question had been discussed in the Académie de Médecine, following the report of a commission, that he finally admitted the communicability of syphilis by "secondary" lesions.

3. The *physiological secretions* of syphilitic persons—the milk, saliva, urine, perspiration, and tears—most probably are not vehicles of the syphilitic poison. They may possibly contain it, but in such an exceedingly dilute state as to be innocuous. However, one of the physiological secretions, the *semen*, seems to form an exception to this rule (vid. p. 50).

In reference to the *milk*, there are a number[1] of instances on record of syphilitic nurses suckling healthy children for a long time without infecting them. H. Lee relates an interesting instance of this kind.[2]

A married woman was admitted to St. George's Hospital, October 5, 1864. Since her last confinement she had taken another child besides her own to nurse. This strange child proved to be syphilitic, and, in consequence, the woman had an ulcer of the breast, which was followed by a characteristic eruption. The woman had always nursed the children from different breasts, so that her own child did not come in contact with the breast which was infected. This child remained healthy, although the mother continued to nurse it for six months after the outbreak of the eruption.

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[1] *Dugès*, de l'innocuité du lait des nourrices atteintes de Syphilis, etc. Thèse de Paris, 1852. *Lancereaux*, l. c., p. 481. *Zeissl*, p. 30.—*Köbner*, l. c., p. 60, 98, 100, 110, 113, 130.

[2] British Medical Journal, 1868, Nov. 28.

The frequent communication of syphilis from nurses to sucklings does not take place, then, through the medium of the milk, but in consequence of the accidental presence of some local syphilitic lesion upon the nipple.

But Zeissl states that in cases where syphilis in nurses had become latent in consequence of a mercurial course, so that neither upon the nipples, nor on the lips, nor elsewhere were there any outward syphilitic manifestations, he has, nevertheless, seen condylomata develop upon the lips and anus of the suckling. In regard to the manner of transmission in such cases Zeissl does not venture to express a positive opinion.

4. With regard to the *infectious nature* of *pathological secretions*, not properly belonging to syphilis, a definitive conclusion is as yet impossible. The successful inoculation of syphilis with gonorrhœal pus (Hunter), with pus taken from chancrous pustules and buboes (Wallace), from chancrous pustules produced by artificial inoculations (Bidenkap), the unfortunate accidents where syphilis has been communicated from vaccine vesicles, all apparently speak in favor of these pathological secretions being vehicles of the syphilitic poison. However, it is very probable that in all of these cases the communication of the syphilis was due to the admixture of blood with the secretions, or of disintegrated portions of tissue from a syphilitic local affection.

The opinion has recently been expressed by certain English physicians that muco-purulent, urethral, or vaginal discharges are not only vehicles of the syphilitic virus, but under certain circumstances also are direct manifestations of the syphilitic disease.

H. Lee[1] believes that the secretion of any mucous membrane in a syphilitic person, if in a state of irritation, is capable of acting in this manner. According to him, a slight muco-purulent discharge from the urethra, such as may occur in a person formerly affected with syphilis, after immoderate sexual indulgence (excluding the possibility of a fresh contagion with syphilis or gonorrhœa), may become the medium of syphilitic contagion. And J. Morgan[2] says that women having no discharge from the vagina at the time of their admission to the hospital, in the first stage of the disease, yet a few weeks later, when the secondary symptoms appear, very frequently have such discharges, which are then capable of communicating syphilis.

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[1] *H. Lee*, Syphilitic Urethral Discharges, St. George's Hosp. Reports, Vol. VI., 1873. —Art. Syphilis, in Holmes' System of Surgery, Vol. I., 1870, p. 477.

[2] On Syphilitic Gonorrhœa, Med. Press and Circular, Jan. 17, 1872.

Discharges of this sort, in women with constitutional syphilis would, therefore, have to be regarded as a symptom of syphilis; probably they are due to a catarrh of the uterus. A syphilitic urethritis is admitted by Vidal [1] and also by Hammond,[2] of New York. Such a urethritis is to be distinguished from gonorrhœa in a syphilitic person. It was claimed that syphilitic urethritis can communicate syphilis much more readily than a simple gonorrhœa.

Berkeley Hill [3] thinks it probable that blennorrhaic discharges in syphilitic persons may infect with syphilis, and Marston [4] has recently endeavored to establish this view by a series of observations. [Professor Tarnowsky, of St. Petersburg, has made some experiments [5] which are interesting in this connection. Eighteen inoculations were performed by him, with blennorrhagic matter from the genitals of syphilitic patients upon healthy persons, and in one instance with a positive result. One of the persons so inoculated developed a well-marked induration, followed by general syphilis. The experiments were done under every precaution, any possible contamination of the matter taken from syphilitic lesions or from admixture of blood being carefully avoided.] [6] Granting that pus-corpuscles are white blood-cells which have escaped from the capillaries, and the infectiousness of the blood being an admitted fact, there is really nothing strange in supposing that these discharges also should be infectious. Still, the possibility that some syphilitic lesion may be deeply seated in the urethra, where it is inaccessible to examination, and so mingle its secretion with the urethral discharge, ought not to be lost sight of.

Pus from an *acne pustule,* due to the use of the iodide of potassium, in a syphilitic person, was inoculated by Diday [7] but without effect. The same was true of serum from an eczema in a person affected with syphilis.

5. Whether *the semen* of a man affected with latent syphilis may be the medium of contagion to the wife, remains yet an open question. Von Bärensprung [8] claims that this can be so only when the wife conceives. Others, as Porter [9] and Langston

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[1] *Auspitz*, l. c., p. 280.

[2] Cited by *Wilks*, Med. Times and Gaz., 1865, Vol. I., p. 436.

[3] L. c., p. 53.

[4] Med.-Chirurg. Transactions. Cited by *Lee*, l. c., p. 477.

[5] Vorträge über venerische Krankheiten, von *Dr. B. Tarnowsky*, A. Professor an d. kaiserl. medic.-chirurg. Academie in St. Petersburg. Berlin, 1872.

[6] Translator.

[7] Gaz. Méd. de Lyon, Févr., 1865. Cited by *Lancereaux*, l. c., p. 473.

[8] Die hereditäre Syphilis. Berlin, 1864, p. 51.

[9] Dublin Quarterly Journal, May, 1867.

Parker,[1] have reported cases which tend to show that infection of the wife may take place without conception, solely through the direct action of the semen, and at the same time without the production on her part of any discoverable primary lesion. The difficulty experienced in ascertaining the real facts in such cases is materially increased from the fact (to be again referred to later) that the primary lesion upon the internal genitals of the female is often very superficial, and lasts but a short time. H. Lee is of the opinion, however, that in these cases the semen does not cause the infection of itself, but only through the admixture with it of syphilitic virus from the urethral mucous membrane.

On the other hand, the virulence of the semen of a syphilitic father *for the child he begets* is an unquestionable fact.

In this connection we proceed at once to discuss *the transmission of syphilis by inheritance*, for, although this subject belongs properly to the chapter upon Infection, it embraces certain important points of difference from other modes of infection, which demand for it a separate consideration.

The Hereditary Transmission of Syphilis.

W. van Rosen, Om afkommet af Syphilitiske, etc. Kjöbenhavn, 1859, translated by Horning in Behrend's Syphilidologie, Neue Reihe, III., 1861.—*von Bärensprung*, Die hereditäre Syphilis. Berlin, 1861.—*Jonathan Hutchinson*, A Clinical Memoir on Diseases of the Eye and Ear, consequent on Inherited Syphilis; with Commentaries on the Transmission of Syphilis from Parent to Offspring, etc. London, 1863.—*Ibid.*, On Inherited Syphilis. London Hospital Reports, Vol. II., 1865, p. 145.—*Auspitz*, l. c., S. 209.—*Mireur*, Essai sur l'hérédité de la Syphilis. Thèse de Paris, 1867.—*Lancereaux*, l. c., p. 501.

If a *syphilitic father* impregnates a healthy ovule, and the fœtus turns out to be syphilitic without the mother becoming similarly affected, it is without doubt the *semen* that served as the vehicle of the syphilitic poison. Again, the ovule may be developed in the ovary of a *syphilitic woman*, and having received the germs of disease from the mother-soil that produced it, the fœtus will be syphilitic, though the ovule was impregnated by healthy semen. Here we cannot speak of an infection properly, since the ovule is merely a constituent part of the maternal organism, and as such has imbibed the disease-poison. Finally, there is a third case, where the *mother* acquires syphilis *during the time of gestation*, and infects the developing fœtus through her blood.

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[1] Med. Times and Gazette, July 4, 1863.

The hereditary transmission of syphilis was accepted as a fact even by the physicians of the sixteenth century. John Hunter,[1] on the contrary, did not admit it. At the most, he admitted only that the fœtus in utero might become infected with a portion of the same poison which infects and is absorbed by the mother, but not that it was infected in consequence of the maternal disease. Hunter doubted the inheritance of syphilis because he did not regard the so-called constitutional syphilis as infectious. Ricord, who shared Hunter's view with regard to the latter point, still admitted the hereditary transmission of syphilis as an exception to the rule. Others, while granting that children are sometimes born with syphilis which they appear to have inherited, have supposed with Kluge[2] that the infection only took place during the act of delivery. Kluge did not regard the cases of congenital syphilis, where the mother's organs of generation were afterwards found free from local affections, as really syphilis, but referred them to the uncertain domain of scrofula.

But unbiased observations gradually again gave currency to the views which had been already expressed by Paracelsus long before, and again, in the beginning of this century by Swediaur,[3] viz., that syphilis may actually be inherited; and moreover, according to Swediaur, that it is more commonly so from the father only. Vassal,[4] Cullerier,[5] and others asserted, on the other hand, that only through the mother was syphilis transmitted to the fœtus. Quite recently this subject has been more thoroughly investigated, and the conclusion arrived at has been, that syphilis in the child may come from the father alone, without any co-existent disease in the mother. Indeed, the researches of von Rosen and of Jonathan Hutchinson indicate that the infection of the child is most commonly due to the father alone. E. Fränkel[1] has also recently arrived at the same conclusion from examinations of the placenta; fourteen out of seventeen mothers, whose placentæ were found to be syphilitic, appeared perfectly healthy. This predominance of the paternal influence is such, that if the husband is healthy, but the wife syphilitic, the probability of the succeeding offspring becoming gradually free from syphilis is greater than when, on the other hand, the wife is healthy and the husband syphilitic (Hutchinson).[2] (Compare below.) Further, the fact has been established by numerous observations, that a man who at the time is apparently free from disease, or has been so for a number of years, but at some former time was syphilitic, is still capable of transmitting syphilis to the child he begets.

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[1] L. c., p. 383.

[2] *Auspitz*, l. c., S. 209.

[3] Traité des mal. vénér. Paris, 1801, t. II., p. 177.

[4] Mém. sur la transmiss. du virus vén. de la mère à l'enfant. Paris, 1807. (*Lancereaux.*)

[5] Mém. de la Soc. de chir., 1857, t. iv. p. 230. (*Lancereaux.*)

According to Hutchinson,[3] syphilis of both parents is more certain to cause disease in the child than where but one of them is affected; in this case also it is probable that the disease in the child will be severe. Nevertheless, cases have been known (Boeck, Köbner) where both parents were suffering from general syphilis, and yet produced healthy children. The shorter the space of time since the infection, or since the outbreak of the general symptoms in the parent, the severer is the infection of the offspring. Hence children that are born later, after the lapse of a long interval from the above period, have a greater chance of escaping the disease. Hutchinson,[4] however, calls attention to the fact that exceptions to this rule occur where the affected parent or parents have become greatly broken down under the influence of the disease, or else where the mother, through many successive pregnancies, becomes more and more infected, in a manner to be described hereafter; so that in the later offspring it is not the influence of the diseased father alone that comes into play, but that of the diseased mother also. In this way are to be explained those cases where certain of the children in a family have shown only slight evidences of infection, or perhaps none at all, while those born later have been profoundly diseased. Zeissl[1] even mentions cases where syphilitic mothers have brought forth at one delivery healthy, and at the next syphilitic children. But there is the possibility here, if the first child were healthy, that syphilis had been acquired by one of the parents shortly before the procreation of the syphilitic child. Campbell (cited by von Rosen) has observed a case in which a syphilitic mother gave birth to twins, one of which was dead and in a state of maceration, while the other at first appeared quite normal, but a few weeks later showed symptoms of syphilis. Consequently both fœtuses were in different degrees syphilitic.

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[1] *E. Fränkel*, Ueber Placentarsyphilis. Archiv für Gynaekologie, B. V., 1873, S. 45.

[2] L. c., p. 208. Aphorism XI.

[3] L. c., p. 207. Aphorism VII.

[4] L. c., p. 210. Aphorism XVIII.

Hence, in view of what has been said, syphilis may be transmitted to the offspring either through the condition of the ovule (syphilitic mother), or thruogh that of the semen (syphilitic father), or from a combination of diseased states in both. Should the father be healthy at the time of procreation, and the mother acquire syphilis during gestation, the child will escape infection, unless the mother becomes syphilitic before the seventh month of pregnancy (Boeck,[2] Fränkel.[3])

Infection during the act of delivery does not properly belong here, but rather to the chapter on Infection. Moreover, this mode of infection has not yet been established with certainty, a fact which is pointed out by von Rosen,[4] who, however, admits the possibility of such an occurrence. Fränkel also is of the opinion that it has not been clearly established.

Whether the syphilitic poison can continue to exist in adults, who in their youth suffered from hereditary syphilis, in sufficient amount to transmit the inherited disease to their offspring, that is, whether *syphilis is transmissible into the third generation*, must be regarded still as an open question. Hutchinson[5] called attention to this point more particularly, and with the exten-

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[1] L. c., p. 302.

[2] *von Rosen*, l. c., p. 183. *Auspitz*, l. c., p. 212.

[3] L. c., p. 48.

[4] L. c., p. 185.

[5] London Hosp. Rep., Vol. II., p. 153. Reynolds' Sys. of Med., I., p. 300.

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sive material at his command he has made an effort to collect cases bearing upon the question. Out of eight instances in which persons with evidences of inherited syphilis had children, but one was found where the child showed signs of syphilis. It was the following case:

> A respectable young woman came to him for an inflammation of the eyes. She had typical interstitial keratitis, the characteristic notched teeth, and the characteristic physiognomy. She was nursing her first two-months-old child, which, in spite of the mother's assurance that it was perfectly healthy, was found, upon inspection, to be covered with coppery spots, and had condylomata about the anus, and coryza.
>
> Hutchinson meets the possible objection that the father or mother of the child might have been suffering from acquired syphilis, with the statement that he had had the father under treatment for a long time for a sycosis, which was not benefited by the iodide of potassium, and the most thorough examination of the man for syphilis showed no evidence of the disease. With regard to the woman, there was not the slightest ground for the suspicion of acquired syphilis, and moreover, the fact of her having inherited the disease rendered an acquisition of it improbable.

Therefore, Hutchinson is disposed to regard this case as an instance of *inheritance of syphilis in the third generation.*

The syphilis poison evinces a very peculiar modification of its action *when it operates through the fœtus, procreated by a father affected with latent syphilis, upon the pregnant mother.* Women that go through a number of such pregnancies begin gradually to suffer an impairment of health, without ever being infected in the ordinary way. A modified infection ensues which lacks the primary local affection, together with the stages of eruptions and condylomata. Gradually increasing pallor and emaciation, alopecia, glandular enlargements, isolated bony nodes, gummata of the cellular tissue, or ulcers of the mucous membranes, or psoriasis palmaris, are the sole affections which these women present (Zeissl, Hutchinson). Zeissl[1] states that such women often complain of profuse menstruation, or abort when they become pregnant. Ricord, Diday, Depaul, as well as Hutchinson, claim that this contamination of the maternal organism, termed by the French writers "*choc en retour*," is the result of a resorption of syphilitic embryonic fluids, the embryo owing its disease to the father. According to Hutchinson[1] the symptoms of a syphilis acquired in this way often do not appear before the climacteric, or even later. This manner of becoming infected must not be confounded with the mode of infection described by von Bärensprung, viz., that which takes place through the semen, with coincident conception. The latter is of the same nature as any ordinary infection, and von Bärensprung states that in these cases manifestations of syphilis generally occur in the tenth week of gestation.

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[1] L. c., p. 43.

An event which is theoretically possible, but which, practically, has never been actually observed, remains yet to be mentioned, viz., where a woman—who has escaped contagion before pregnancy, as well as infection during her gestation, through a fœtus inheriting syphilis from the father—becomes infected during the act of delivery, from some syphilitic lesion upon the child's body.

This somewhat obscure mode of infection, together with the inheritance of syphilis, constitutes the only really positive examples of a syphilis without any manifest primary lesion, or the so-called *syphilis d'emblée.*

The virulence of the syphilitic poison is not alike in all stages of the disease, nor is the virus uniformly distributed throughout the body at all times in the course of the disease. Else how were it possible to account for the fact of a father, affected with latent syphilis, procreating at one time a healthy child, and next a syphilitic one?

As mentioned already, *the virulence* of syphilis is most intense in the primary lesion; it is of almost equal intensity in the various local affections of constitutional syphilis, as in the flat condylomata and the pustular syphilide. So long as these manifestations of the disease are present in a patient, the disease may be communicated in the ordinary manner. But whether the contents of the gummy tumors, and the secretions from the ulcerating tubercles of the skin, or, in general, whether the local affections of the tertiary period are infectious, is a question which has not been satisfactorily determined. Diday[1] performed inoculations with the blood of persons in the tertiary stage of syphilis, and invariably with a negative result. Von Bärensprung states that from observation as well as experiment he is persuaded that so soon as the syphilis has passed into the destructive forms of its tertiary stage, it ceases to generate an inoculable virus; and clinical observation seems to confirm this view, both in respect to direct contagion and with reference to the inheritance of the disease. Concerning the latter point, no great concurrence of opinion prevails, though the tendency is to regard the probability of hereditary transmission to offspring as less in this stage than in the secondary period.

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[1] L. c., p. 209. Aphorism XVI.

THE INFECTION.

In whatever way the poison of syphilis comes in contact with a healthy body, it is necessary to infection that it should get underneath the epidermis, or beneath the epithelium of the mucous membrane. The only real exceptions to this, so far as at present known, are the modes of transmission mentioned above, namely, by inheritance or the transmission of the disease through an infected fœtus to the mother.

That sexual intercourse was the most frequent occasion of infection, was the almost universal belief of physicians and laity, even at the end of the fifteenth century, and this still at the present day continues to be its most prolific source. Consequently the genitals are the most common seat of the infection. The transmission of the virus from diseased to healthy persons is not always direct; a healthy person may act as conveyor of the poison, and be the means of its transmission, without this person contracting the disease. This was maintained also by Cataneus,[2] Fernelius,[3] and other writers of the sixteenth century, and has been confirmed by many more recently.

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[1] Gaz. méd. de Paris, 1846. *Lancereaux*, l. c., p. 478.

[2] *J. Cataneus* (1504): Quarta causa poterit esse coitus cum sana eum qua de proximo coiverit infectus, semine adhuc in matrix existente. Aphr., I. p. 140.

[3] Aphr., I. p. 613.

But other locations and other modes of infection are sufficiently common, particularly in females, and information in this regard is especially important for the sake of effective prophylaxis. It should be borne in mind that every part of the body accessible to the contagion may afford a lodgment for the poison. Next to the genitals, the commonest seat of infection is the mouth, especially the mucous membrane of the lips, and in the great majority of cases the contagion is effected by local secondary lesions, communicated from one mouth to another in *kissing*. The comparative frequency of infection upon the mucous membrane of the lips in 11,491 cases[1] of syphilitic primary lesions, arranged according to their situations, was computed at 3.2 per cent., while the seat of infection in 91.1 per cent. of these cases was the genitals, or the parts in their immediate vicinity, in 1.7 per cent. the anus, and in 3.9 per cent. other portions of the body.

The poison may be inoculated by kissing, not only upon the lips or tip of the tongue, but upon other parts of the face, as the cheeks, the eyelids, forehead, etc. Next to kissing, the most common source of infection, where the syphilitic poison is conveyed directly to the lips or other parts of the mouth, is the *custom of employing hired nurses.* Still there must be more instances of the poison being communicated from the mouth of a child with inherited syphilis to the breast of a healthy nurse[2] than where a nurse with syphilitic lesions of the nipple inoculates the mouth of a healthy child. Especially in countries where the custom prevails of having infants raised by nurses in the country, numerous instances have recently been noted where syphilis has been widely spread by a single diseased nurse or a single syphilitic infant. Ricordi[3] has reported several remarkable examples. The danger of this mode of infection can scarcely be overrated, and, in the choice of a nurse, renders the most thorough inspection and the most searching inquiries an imperative duty.

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[1] These figures are taken from a paper by *Dr. F. R. Sturgis*, in the Am. Jour. of Med. Sciences, January, 1873, and were based upon observations by Fournier, Bassereau, Clerc, and Rollet.

[2] Even *Torella* says, in 1500 : " Sæpius vidi infantum infectum hoc morbo multas nutrices infecisse." Aphrod. I., p. 504.

[3] *Ricordi*, Sifilide da allatamento. Milano, 1865.

Not only is syphilis communicated to women from suckling infants, but it was not long ago that this frequently happened through the custom, now almost obsolete, of drawing out the nipples of women, either just before or after delivery, by sucking them, or of emptying them in this manner when distended with milk. There was formerly a class of women who made this a business, and in the writings of the sixteenth century, among the different modes of infection, this is mentioned almost invariably. As late as 1825 F. Bourgoigne[1] published an incident of this sort in which through one such woman a dozen women were infected.

The mucous membrane of the lips and mouth is sometimes infected also in *mediate ways*, through the use of eating and drinking utensils, tobacco pipes, and cigar-holders (indeed through smoking a cigar stump that had been thrown away), these articles having previously been used by persons with syphilitic affections of the mouth. The spread of the disease in this manner in the glass factories where the custom prevails of passing the blow-pipe from one mouth to another, is a familiar instance in point.

If, in the event of an immediate or mediate communication with the virus, the epidermis of the lips is intact, but there happens to be a solution of continuity in the epithelium of the mucous membrane upon the tongue or palate, with which the poison is brought into contact by some means, as by the food for instance, infection may take place upon the tongue or in the deeper parts of the mouth, and the primary lesion develop there. Cases of this sort are reported by Rollet, Köbner,[2] and Fournier, and a case in which a sugar pastil was passed from one mouth into another and caused infection, is said to have been observed in Hardy's clinic in Paris.[3]

Physicians and *midwives* have not infrequently been inoculated upon the fingers in cases where they have undertaken obstetrical examinations with wounds upon these parts. Antonius Gallus[1] related such a case in 1540. Inoculations of the fingers are also observed, now and then, under other circumstances. An inoculation of the hand through the bite of an individual with a syphilitic lesion of the mouth was observed by Hutchinson and Sydney Jones,[2] and cases have been often described in which the disease was communicated by a scratch of a dirty finger-nail bearing the poison; infection in very uncommon situations may perhaps be effected sometimes in this way.

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[1] *Fournier*, l. c., p. 54.

[2] *Köbner*, l. c., 54 and 61.

[3] Brit. Med. Jour., 1872, Vol. II. p. 606.

Surgical instruments have likewise occasionally been the means of conveying the syphilitic poison to healthy persons. It is reported than in the year 1577 an epidemic of syphilis took its origin from a public bathing-room in Brünn, where over 180 persons were infected in the operation of cupping. Such occurrences were by no means isolated.[3] Public attention was early drawn to the danger of infection at the baths, as appears from the fact of an ordinance being issued by the Nuremberg Rath, which admonished the bathers to caution in this regard.[4]

In several cases noted by Petry, of Gratz, syphilis was inoculated in the operation of *tattooing.*[5] In the *ritual circumcision* syphilis has occasionally been communicated not only by means of the instrument employed, but through the mouth of the operator in the act of completing the rite by sucking the wound.

Infection by means of a Eustachian catheter, previously used for syphilitic persons, has been observed repeatedly, and suggests the possibility of communicating the infection by means of unclean tongue-spatulæ, laryngoscopic mirrors, and other like instruments.

There has arisen in modern times, unfortunately, not a very infrequent source of syphilitic infection, in the practice of *vaccination.* But in view of the great importance that attaches to this mode of transmission, it is proper to treat at some length of the circumstances under which it occurs.

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[1] Aphrod., I. 463.

[2] Brit. Med. Jour., 1872, I. p. 14 and 313.

[3] *Hirsch*, l. c., p. 371.

[4] *Waldau*, vermischte Beiträge zur Geschichte der Stadt Nürnberg, B. IV. S. 409.

[5] *Auspitz*, l. c., p. 241.

The Transmission of Syphilis by Vaccination.

Viennois, De la transmission de la Syphilis par la vaccination. Arch. génér., 1860.—*Auspitz*, l. c., p. 243; and *Lancereaux*, l. c., p. 490.—The very copious literature of this subject is given in full in the above works.

Passing over the less authentic cases reported in the first decade of this century, we shall confine ourselves to well-established and more recent instances.

In the year 1849 a veterinary surgeon in Coblenz vaccinated twenty-six persons from an apparently healthy child. In nineteen of these the vaccine pustules turned, in from three to four weeks, into syphilitic ulcers. The child from which the virus had originally been taken, broke out with a roseola a few days after the vaccination, and ten days later died with hydrocephalus.[1]

On the 16th of June, 1852,[2] the public physician, Hübner, in Hollfeld, Bavaria, vaccinated thirteen healthy children with lymph from the three-months-old child, Keller, regarding whose appearance we have no information, but which two months after the vaccination died with atrophy.

Eight months later the vaccinated children, which had meantime fallen ill, were medically examined under a legal requisition; *eight of the vaccinated children and nine of the mothers were suffering from lues universalis.*

From one of the syphilitic children between twenty-five and thirty children of another community had been vaccinated, and one of them had been infected; from one of the first five who remained healthy twenty-five others were vaccinated, of which again one became syphilitic.

A still more unfortunate instance occurred in the year 1861 in Rivalta,[3] near Acqui, in Upper Italy. On the 24th of May, 1861, the surgeon Cagiola vaccinated the eleven-months-old child, G. Chiabrera (both the child and its parents appearing healthy) with virus from the lymph depôt at Acqui. On the 2d of June, *i.e.*, nine days afterwards, forty-seven others were vaccinated from this child, and it is stated that in this vaccination blood was noticed upon the lancet. Thirty-eight of those vaccinated became affected with symptoms of general syphilis. One of these thirty-eight (Luise Manzoni) was used on the 12th of June to vaccinate seventeen other children, of which seven became likewise syphilitic.

Subsequent investigation elicited the fact in regard to the child Chiabrera, that two months before its vaccination it had been in constant communication with a woman who was evidently syphilitic, and had been nursed at her breast. This woman had infected her sister's child by suckling it, and through it her sister also. On the 8th of October (over three months from the vaccination) the child Chiabrera showed, besides general debility and a diarrhœa, an erythema about the anus, an excoriated tubercle upon the foreskin, and complete alopecia. Its mother had an ulcer upon one nipple, a fresh scar upon the other, and on the 7th of November, flat condylomata upon the labia. The father was healthy, and showed no traces of antecedent syphilis.

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[1] *Wegeler*, in the Prussian Vereinzeitung, 1850, 14.

[2] Aerztl. Intelligenzblatt, 1853.

[3] *Pacchiotti*, Sifilide transmissa per mezza della vaccinazione in Rivalta. Torino, 1862. *Auspitz*, l. c., p. 248.

With reference to the second child from which lymph was taken, Luise Manzoni, it appeared that at first she had had ulcers at the point of vaccination, and upon the 2d of August there was observed a papular exanthem upon the back and limbs, with flat condylomata about the mouth and genitals. She died with marasmus on the 10th of September.

For the sake of showing to what devastation such an occurrence may give rise, it may be mentioned that, altogether, eight children died, and twenty-six mothers and nurses, five husbands, and three brothers and sisters were infected in consequence of these vaccinations.

With reference to the mode of transmission of syphilis in vaccination the following case[1] of Sebastian is significant.

On the 19th of March, 1863, from a ten-months-old child that had been vaccinated itself eight days before, Sebastian, at the request of the child's mother, vaccinated the children of two of this woman's friends. As S. was about to make the last puncture in the vaccination of the second of the two children, the child from which he was taking the lymph made a sudden movement, and the lancet was driven in so deeply that a drop of blood was left upon the point which was inoculated with the lymph.

In twenty-two days after, S. saw the child again. The vaccine pustules had all run their normal course, but the point where the last puncture was made, the situation of which had been carefully noted by S., presented the appearance of a genuine pseudo-chancre. It was covered with a dark conical scab, and around it were numerous lenticular papules. Later, a considerable induration was developed, roseola and tubercles appeared, and finally swelling of the glands.

S. now examined the child from which the lymph had been taken, whose vaccine pustules were quite cicatrized, and found upon it an extensive papular syphilide. The cervical glands were swollen, and upon the genitals were several suspicious-looking papules. The child's father had formerly had a chancre, and ever since had had impetiginous ulcers upon the scalp, spots on the body, and flat condylomata.

The other *child vaccinated remained perfectly healthy.*

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[1] Gaz. des Hôpitaux, 22 Oct., 1863. *Auspitz*, l. c., p. 250.

Very recently, too, observations have been made with regard to the inoculation of syphilis in vaccination, since the latter, on account of the extensive epidemics of small-pox of late years, has been practised more generally than formerly.

A case which is interesting in this connection, and noticeable also from the circumstance of but one of the four vaccine pustules turning into a syphilitic ulcer, was communicated by Thomas Smith[1] to the Clinical Society in London.

In the section for public hygiene in the Natural Philosophy Association in Leipzig (1872)[2] Geh. M.-Rath Dr. Eulenberg, of Berlin, referred to a recent incident in the Rhine province that came officially under his notice. A child, three months old, which appeared quite healthy, was used by a physician for vaccination. The child appeared to be such a fit subject for this that the physician vaccinated several of his relatives from it. Of one hundred and forty individuals who were vaccinated with lymph from this child, fifty became syphilitic. The local symptoms made their appearance in three weeks, the general manifestations in from five to six weeks. The child itself, three months later, had condylomata. As subsequently ascertained, its parents had been syphilitic some years before; the mother had had repeated miscarriages, and this child was the first that was carried to term. E. remarks that in the above case he was assured that only clear lymph without admixture of blood had been used.

A number of cases, which came under Hutchinson's notice, and were reported by him to the Medical and Chirurgical Society in London,[3] are also very instructive.

In the first series of observations twelve persons had been vaccinated from a child that to all appearance was healthy. The vaccina ran its usual course, but in ten of those vaccinated, indurated ulcers formed in the eighth week. They were all treated with mercury, and in four of them symptoms of general syphilis appeared five months after the vaccination. The child from which the virus had been taken, at the time of the vaccination presented an appearance of perfect health. Two months afterwards, when H. saw it, in addition to certain other rather suspicious appearances, there were five small, round condylomata about the anus, which the mother, who was disposed to ridicule the idea of anything ailing her child, stated had not been there over one week. The pock mark was of normal appearance. The child was unquestionably affected with inherited syphilis, although there was no evidence of the mother's having had syphilis. As to the father's health, nothing could be ascertained, inasmuch as he declined an examination.

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[1] Transactions of the Clinical Society of London, Vol. IV., 1871, p. 53.

[2] Tagblatt, S. 194.

[3] Medico-Chirurgical Transactions, Vol. LIV., 1871.—Lancet, April 7, 1873.

In these observations it is noteworthy that the first two who were vaccinated were not infected, and that the third, who was vaccinated on both arms, had a syphilitic ulcer upon only one of them, which developed in a vaccine scar; furthermore, that indurated ulcers formed not only in the scars of the vaccination, but at points of inoculation where there had been no vaccine pustules.

A second series of observations, concerning vaccinations of mostly older children, was reported at the same time, and is worthy of mention inasmuch as in this instance also the child from which the virus was taken, when examined by H. three months after the vaccination, excepting for a slight tendency to hydrocephalus, together with one small condyloma near the anus, might have been taken for a perfect pattern of health. And he appeared thus, at the time of the vaccination, to the parents of several children that were vaccinated with his lymph.

H. presented a third series of cases before the same society in the year 1873. Of these cases we will call attention to one instance where the vaccine virus did not take, but in four weeks afterwards one of the spots inflamed, and an ulcer followed, which remained for three months, together with a skin eruption and iritis.

Besides these the English literature of the last three years contains a number of observations of the same class.

From the observations reported the obvious conclusions are—

1. *That syphilis can be transmitted by vaccination.*

2. *That the course of the vaccine pustules in children already syphilitic at the time of vaccination may be perfectly normal and leave scars of the usual appearance.*

3. *That in cases vaccinated from such children, unless the inoculation fails altogether, either the vaccina may take alone, or the syphilis alone, or both may take together and go on to their full development.*

If both take, then the vaccination runs its course in the usual manner. Then, either after complete cicatrization of the vaccinated spot, or while the scab remains still adherent, certain changes take place (usually after a period of incubation of from four to five weeks, reckoning from the time of vaccination) which consist in induration and ulceration.

If only the vaccine virus takes, the course is that of a normal vaccination.

If the syphilis only takes, there follows at the point of inoculation, after a period of incubation of some weeks, a syphilitic primary lesion.

Now, inasmuch as when healthy persons are vaccinated with lymph from a vaccine vesicle in a child, then syphilitic, these persons do not all acquire syphilis, though the vaccina perhaps takes effect in every case; and furthermore, since in those who thus acquire syphilis all of the vaccinated points do not develop syphilitic primary lesions, the presumption is that in such inoculations the vaccine and syphilitic poisons are transmitted separately, that is, the syphilitic poison is not intimately combined with the contents of the vaccine pustule, but is only mingled with them mechanically and in small amount. Or perhaps both are not contained in the vaccine vesicle together at all, but are mingled together upon the lancet purely by accident.

The negative results of experimental inoculations of healthy persons from vaccine vesicles in persons manifestly syphilitic, so far as the transmission of syphilis is concerned, speak in behalf of the supposition that the pure contents of a vaccine vesicle, developed in a syphilitic child, do not comprise the syphilitic poison. In these inoculations nothing else than vaccina was produced.[1]

Certain cases, particularly that of Sebastian (vid. above, p. 62), appear to indicate that the syphilitic agent resides in a mixture of blood with the vaccine lymph, but that the lymph by itself is free from it.

Hence we should expect that the probability of transmitting syphilis by vaccination was very slight; that it is so, and that it may take place only under certain coincidences, we conclude from the fact that such unfortunate events as we have just narrated are of comparatively rare occurrence; whereas, considering the commonness of syphilis in large towns, it can hardly be so rare an accident that lymph is taken from children with inherited syphilis for vaccination.

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[1] *Auspitz*, l. c., p. 252.

According to a communication from Joukoffsky,[1] fifty-seven healthy children were vaccinated in the St. Petersburg Foundling Asylum, in the years 1865–7, from eleven children, which at the time of the vaccination were suffering from hereditary syphilis, without one of the fifty-seven being infected with syphilis. J., however, remarks that the vaccinating physicians in this institution particularly avoid mixing blood with the lymph.

But the theory that syphilis is transmitted not by the lymph of itself, but through blood being mingled with it, does not, after all, explain such cases as that of Luise Manzoni, who was not syphilitic when vaccinated, and yet out of seventeen who were vaccinated from her seven had syphilis in consequence. It is not supposable that ten days after she had been inoculated her whole blood had become infected with syphilis, and the supposition that a hitherto latent syphilis was reawakened in consequence of the vaccination is, in the present case, purely hypothetical and without foundation. In the latter event, by analogy with other cases of latent syphilis, she would have had no syphilitic local affection at the point of inoculation, whereas, on the contrary, this affection ran its course in her as in the inoculation of syphilis upon a healthy organism. At the most, we may conceive of the syphilitic poison in this case beginning to develop in the tissues locally, at the point inoculated, with greater rapidity than this commonly happens, though for this theory also we have not all the necessary data from the history of the case. This supposition is the same in effect as that of Gamberini,[2] which Köbner[3] also seems to entertain, namely, that in the vaccination-syphilis, generally, the base of the pustule embraces a syphilitic local affection. This theory would, however, apply to the few cases only in which the primary affection is developed immediately from the vaccine pustule while the scab is forming, and even then it does not wholly apply, since in these cases too, at the time when the lymph is generally taken for vaccination, that is, while the vesicles or pustules are still present, these latter differ in no respect from normal vaccine pustules. And as several of the cases observed by Hutchinson show more particularly, the vaccina often runs its course quite normally to cicatrization, after which induration and ulceration take place in the scars.

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[1] St. Petersburger med. Zeitschr., 1872, 1, p. 73.

[2] *Auspitz*, l. c., p. 265.

[3] Dissertation by *A. Rahmer*. Breslau, 1869. Refer to Archiv f. Dermatologie und Syphilis, B. II. p. 297.

Still greater difficulties present themselves with regard to the explanation of Hübner's case, where from one of the first vaccinated children, but which remained healthy, twenty-five others were vaccinated, of which one became syphilitic; unless we suppose, considering that this is such an isolated instance, that the child had in the interval after its vaccination acquired syphilis in some other way.

Moreover, in those already affected with constitutional syphilis, the base of the vaccine vesicle is not the source of the syphilitic poison; but thin layers only of tissue and the walls of the blood-vessels separate the contents of the vesicle from the blood, which latter contains the syphilitic poison, without doubt, in certain periods of the disease. Therefore many are of the opinion—Hutchinson[1] among others—that when the vesicle has been irritated for some time, the serum of the blood transuding from the vessels may contain the syphilitic poison, and is thus capable of transmitting the disease in the same manner as the blood itself.

I have convinced myself repeatedly that a few blood-corpuscles, both red and white, occur in the purest lymph that first exudes from a seven-days-old vaccine vesicle.

This supposition is necessary to the explanation of those cases in which we are assured that no admixture of blood with the lymph could have taken place.

Two other possible events in connection with the transmission of syphilis in vaccination must be noted here. It may happen, namely, that a healthy child from whose arm lymph is being taken, may be infected by means of the repeated introduction into the vesicle of a lancet, which has just been used to scarify the arm of a syphilitic child, a portion of whose blood remaining upon the instrument is deposited within the vesicle.

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[1] Lancet, April 7, 1873.

Again, in vaccinating a large number of adults, one of whom happens to have syphilis, the disease may be easily communicated both to the child furnishing the lymph, and to one or more of those vaccinated immediately after this syphilitic individual, by means of the same instrument, which has, meantime, not been carefully cleaned.

Finally, there remains to be mentioned an occurrence which, especially with the laity, has sometimes given occasion to erroneous inferences: An apparently healthy child, five or six weeks old, is vaccinated; two or three weeks later it is covered with an eruption, and is evidently syphilitic. In this case the vaccination had nothing to do with the syphilis, or, at the most, it but hastened the outbreak of a hitherto latent inherited syphilis, which would have manifested itself at any rate in a few weeks. This is the view maintained by Viennois.

In this connection allusion may be made, chiefly for the sake of their historical interest, to those cases where syphilis has been transmitted in transplanting a sound tooth from the jaw of one person into that of another. This operation seems to have been pretty common in Hunter's time—at the end of the previous century—but is now no longer performed. But inasmuch as at the present day a decayed tooth is sometimes removed, carefully cleansed of all its diseased portions, filled and replaced, it is not impossible that the practice of transplantation may be revived.

John Hunter[1] relates a number of cases in which local and general symptoms appeared resembling syphilis, but which Hunter, on account of his prejudice in favor of the non-contagiousness of constitutional syphilis, did not recognize as belonging to this disease. The circumstances upon which he based his doubts mainly, were that ulceration about the transplanted tooth did not commence till several weeks after the transplantation; then the sudden and rapid development of general symptoms; the small amount of mercury that sufficed for a cure in many of the cases; and, finally, the absence of ulceration in the mouth or dental socket of the person from whom the tooth had been taken, as well as his freedom from other manifestation of syphilis.

Regarded in the light of our present knowledge of syphilis, many of these cases were unquestionably instances of syphilitic transmission. Since the virulent character of syphilitic blood has been demonstrated by experiment; since we have learned that in the course of syphilis periods of latency occur, during which outward manifestations, or those apparent to the eye, are absent; since we have learned to recognize a period of incubation in syphilis, these cases have lost much of that strange and unusual character in which they appeared to Hunter.

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[1] L. c., p. 483.

SUSCEPTIBILITY TO THE SYPHILITIC POISON.

We have already spoken of the influence which climate, race, constitution, etc., have upon syphilis. We now come to speak of those circumstances that are peculiar to the individual, which may also influence the liability to infection, such circumstances, that is, as tend to decrease or augment the *susceptibility to the syphilitic poison.*

1. With regard to the *disposition in general to incur infection,* it is to be observed, first, that there are persons who expose themselves repeatedly to contagion with impunity, under circumstances where others would become infected at once. We notice a similar immunity in certain people with reference to other infectious diseases also.

In the vast majority of cases this immunity is acquired through some thorough antecedent infection with the specific disease concerned. Any one who has once had small-pox, scarlet fever, typhus, etc., is, as a rule, not liable to these diseases again for the rest of his life. The same is true of syphilis. Not only while an individual is still actually syphilitic, does he possess an immunity with respect to fresh contagion, but for years after all evidences of the disease have disappeared.

By means of this fact many exceptional instances of infection are made explicable. For example, the fact first remarked by Colles,[1] that a child with hereditary syphilis does not infect its mother, though a healthy nurse may contract the disease from it. Another instance is the failure of inoculations of the syphilitic poison upon the person from whom this poison is taken; which fact was made use of by Ricord as an important point of distinction between a syphilitic and non-syphilitic ulcer.

Yet this immunity is by no means so absolute as Ricord claimed. Sometimes very shortly after the infection, before the local affection has yet made its appearance, as well as later, but before the occurrence of general symptoms, it happens that a fresh inoculation of the syphilitic poison produces its local effects the same as usual (see below, the cases of Bidenkap, p. 97). An instance of this occurred in an inoculation made by H. Lee,[1] upon a patient in whom the disease was already pretty well advanced.[1] In a girl who had had syphilis before, he produced an induration five weeks after inoculating her with pus from a syphilitic ecthyma pustule. Moreover, second infections followed by such merely local effects are occasionally met with in practice. Diday and Köbner observed such cases. But Hutchinson [2] has called attention to the liability to confound these cases with the relapsing indurations which occur occasionally without fresh contagion, and which he was the first to describe. Generally, however, the inoculation of secretions from syphilitic ulcers, unless it fails altogether, produces a pustule without incubation, and this pustule may turn into a common soft sore, which does not become indurated.

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[1] On the Venereal Disease, 1837, p. 385. Cited by *Lancereaux*, l. c., p. 489.

But a *second infection* may be followed by *general effects* as well as local. A large number of cases of this "*reinfectio syphilitica*," first described by Zeissl,[3] have been published (Diday,[4] Hugenberger,[5] Köbner,[6] Hutchinson,[7] H. Lee).[8] The following case (which is interesting otherwise also) came under my own observation:

W. L., a man well on in the fifties, came under my care in November, 1867, affected with an icterus that had lasted for several weeks, and was accompanied by other symptoms which pointed to the presence of gall-stones or of an ulcus rotundum ventric. As the icterus increased, the liver gradually increased in size, and a tumor as large as a goose's egg, not tender, and of an elastic feel, appeared just beneath the lower border of the ribs, on the right side, near the mesian line, and was supposed to be the gall-bladder. Before the liver had become markedly enlarged, a transient benefit was at first derived from the use of the Carlsbad salts. The symptoms increased gradually, and pains in the region of the stomach were particularly severe; only by the subcutaneous injection of morphine could they be for the time allayed.

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[1] Holmes' Syst. of Surgery, I. p. 440.

[2] Reynolds' Syst. of Medicine, p. 294.

[3] L. c., S. 58. Zeitsch. d. k. k. Gesellsch. d. Aerzte in Wien, 1858, No. 52.

[4] Archives génér., 1862, Vol. II. p. 26.

[5] St. Petersburger med. Zeitsch., Vol. III., 1862, S. 161.

[6] Berliner klin. Wochenschrift, 1872, No. 46.

[7] L. c., p. 293.

[8] L. c., p. 440.

I was aware that the patient had had syphilis in the year 1864, and that he had also infected his wife, whom I saw frequently at that time, and had treated her for iritis and condylomata of the vocal cords.

The patient was very much debilitated, and as the symptoms showed no tendency to improve, the possibility of a syphilitic affection of the hepatic duct occurred to me, and therefore I resolved to make trial of the iodide of potassium. This was begun on the 8th of February, 1868, and on the 12th inst. I learned that the pains had been absent ever since an attack on the 7th, which was allayed by morphine. Prior to this they had occurred every morning. The icterus had, to be sure, somewhat increased; but, on the other hand, the region of hepatic dulness did not extend as far downwards as upon the 7th inst., and the elastic tumor was smaller and softer. The 17th of February the icterus had also diminished, and the liver was manifestly smaller; the elastic prominence could no longer be felt. The pains did not return, the icterus disappeared entirely in the course of the following weeks, and the patient was then lost sight of. No passage of gall-stones was ever known to have taken place.

February 7th, 1870, the patient again made his appearance, and this time with a *fresh syphilitic infection;* six weeks before he had had a small ulcer upon the frenulum, which healed in three weeks. For fourteen days past he had been feeling very languid, and on the 6th of February he first remarked a red eruption upon the body. I found a slight induration upon the frænum, as if due to cicatricial tissue, a considerable indolent swelling of the inguinal glands of the left side, and a roseola, consisting of slightly elevated spots and rings, which was most marked in the region of the loins, and upon the sides above and below the crista ilei, upon the back, especially along the mesian line, upon the neck, and on the extensor surfaces of the arms and legs. The face, breast, and belly were free. There were no manifestations in the throat. The cubital glands were not enlarged. On the 12th of February the eruption had almost entirely disappeared, only some very slight, no longer elevated spots were still to be seen. Moreover, the patient did not seem to have experienced further annoyance from the affection, for he did not again appear. I met him occasionally some years afterwards, and learned from him that he had had no further symptoms. If any of importance had occurred I should at least have known of it, since during this time I was treating several members of his family.

Concerning the first infection, my colleague, Dr. A. Rasch, of London, who treated the patient, during the attack, in the Eastern Dispensary of the German Hospital, has had the kindness to supply me with the following notes: W. had in April, 1864, an indurated ulcer; in September, affection of the throat. He took mercury from June, 1864, until March, 1865; later, for some time, the iodide of potassium. Whether he had roseola at this time, I was unable to ascertain; he states himself that he did have a slight eruption. He says he has never suffered from pains in the bones.

Therefore, in this case we have an unquestionable instance of a second infection about five and a half years after the first. Its course was very mild.

In the majority of cases a mild course of the disease is observed after a second infection; still not in all. Diday describes two instances of second infection with severe course. But, in general, we may say that a second attack of the disease will be a modified one, and will be milder the earlier it takes place after the first attack. In both of Diday's cases the interval between the two infections was nineteen and a half years; nine mild cases had an average duration of forty-five months.

Persons who have suffered from *inherited syphilis* in their childhood are in later years protected to a certain extent, and if they become infected, the disease takes a modified course in this instance also. Hutchinson[1] met with a case of second infection in a person who had inherited syphilis.

It is a very important and interesting question to decide whether the children of syphilitic parents inherit a certain degree of immunity *without having actually had hereditary syphilis.* Ferguson[2] has ascribed the remarkably mild course which the disease pursues in the inhabitants of Portugal to the thorough saturation of the population with syphilis, and to the immunity thence acquired or inherited; and H. Lee asserts that a similar effect is observed in other countries amongst the common classes, which are peculiarly exposed to syphilitic contagion. Lee regards it as probable that in a family where some of the children bear evidences of different grades of inherited syphilis, and the rest remain entirely free, the latter also inherit a certain degree of protection against the syphilitic poison.

Age does not essentially modify the susceptibility to the syphilitic virus. Only in so far as the period of childhood is marked by a greater tenderness and vulnerability of the skin and mucous membranes will the disease be more readily incurred in the event of an exposure to infection.

There is likewise no difference *in sex* with reference to the susceptibility to the poison.

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[1] Reynolds' Sys. of Med., p. 295, Note. Lond. Hosp. Reports, Vol. II.

[2] Cited by *H. Lee*, l. c., p. 455.

2. The *local predisposition* may be influenced by certain physiological or pathological conditions. Thus, during pregnancy the liability to syphilitic infection is usually increased (von Sigmund), and for the reason that a slight catarrh of the genital mucous membrane is present. And since such a catarrh often exists after menstruation, infection may be incurred more readily at this time also. This will be the case still more if these conditions overstep the bounds of physiology, or if catarrhs of the mucous membrane are present, which are true pathological processes.

Special conformation of particular parts, as a high grade of congenital phymosis, for instance, may augment the local predisposition to receive the virus.

PATHOLOGY.

(SYMPTOMATOLOGY AND PATHOLOGICAL ANATOMY.)

THE PERIOD OF INCUBATION.

In the vast majority of pure, uncomplicated cases of infection with the syphilitic poison, especially therefore in the cases of experimental inoculation of syphilis upon healthy persons, *a period of incubation* occurs which has pretty definite limits. During this period there are no symptoms of any kind, either local or general. It is precisely like the period of incubation which we observe in other infectious diseases, in the acute exanthemata for example. *The length of this period of incubation* in any disease is not solely determined by the specific poison, but is also more or less dependent upon various influences which are for the most part obscure, and the longer the period of incubation pertaining to any disease-poison, so much the more may the duration be affected by these extraneous influences. Nevertheless, so far as syphilis is concerned, a large series of observations, made with reference to this period, show a remarkable uniformity in their results.

Generally from three to four weeks may be taken as the period of incubation for syphilis—that is, *the period elapsing from the infection until the first appearance of* LOCAL *symptoms*. In private practice we see cases now and then which enable us to fix the period of incubation exactly; from my own observation I will adduce the following examples:

F. S. presents himself on the 18th of July with two hard papules, as large as pin-heads, upon the outer integument of the penis, which, he states, have been there only a few days. He has not exposed himself to the risk of infection since the end of June. One of the papules shows a small black point in its centre, and looks like a hard sebaceous follicle; neither of them are red. July 24, that is, four weeks after the infection, the papule upon the right side is somewhat larger and slightly reddened; it is situated in the cutis, is isolated and slightly movable; the epidermis over it is smooth and unchanged. July 30, this little papule has grown larger, as well as the papule upon the left side, and the latter is covered by a small crust. Swelling of the inguinal glands on the left side. Now, two flat papular indurations were developed, of which one grew to the size of a three-cent piece. A few inguinal glands became enlarged on the right side also, and on the 28th of August, about two months after the inoculation, the first traces of the roseola were visible, which was fully developed a few days afterwards.

In the two following cases the periods could be precisely determined to the day:

K. C., infected on the 6th of January; first local manifestation February 5.

O. J., infected on the 30th of January; first local manifestation February 25.

In the first case, therefore, the period of incubation amounted to twenty-nine days; in the last, to twenty-five days.

In the literature of syphilis will be found a number of similar observations. Of especial value are two cases mentioned by Fournier[1] in his paper on the incubation of syphilis. One of them concerned a pupil of the veterinary school, the other a physician, and both made accurate notes of their own cases. In one case the length of the incubation was twenty-eight, in the other thirty-three days.

Of still greater value in this connection than the above observations upon patients, are the results obtained from experimental inoculations of syphilis upon healthy persons. Out of fifty-eight such experiments with which I am acquainted, in thirty-one cases the dates are given with sufficient accuracy to determine the exact period of incubation. These cases are here tabulated.

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[1] *A. Fournier*, Recherches sur l'Incubation de la Syphilis. Paris, 1865, p. 20.

No.	Name of Observer.	Source and Mode of the Inoculation.	Period of Incubation in Days. I. Until the appearance of the local affection.	Period of Incubation in Days. II. From the appearance of the local affection until the outbreak of general syphilis.
1	Waller	Secretion from condylomata in scarifications	24	27
2	"	Blood in scarifications	35	31
3	Lindemann	Secretion from tonsillar ulcer by a lancet puncture	10	3 months.
4	Von Rinecker.	Pus from syph. acne pustule of a hered. syph. child upon a vesicated spot.	20	139
5	"	Secretion of prim. lesion of No. 4 upon vesicated spot	23	bet. 47 & 57
6	"	Secretion of prim. lesion of 5 upon vesicated spot	27	No constit. syph.
7	Palatinate Anonymous (1)[1]	Secretion of flat condyl. inoculated by puncture	17	27
8	" (2)	Secretion from fissures behind the ear inoc. by puncture	23	107
9	" (4)	" " "	15	68
10	" (5)	" " "	17	62
11	" (7)	" " "	18	25
12	" (8)	" " "	25	49
13	" (10)	" " "	36	No general symptoms within a year.
14	" (11)	" " "	22	42
15	" (12)	Pus from the prim. affect. of No. 7	23	45
16	" (13)	" " "	44	No erupt'n.
17	" (14)	" " "	16	48
18	Gibert	Pus from flat condyl. upon vesicated spot produced by ammonia	14 (redness) 18 (papule)	37
19	"	" " "	25	12
20	Guyenot	Pus from flat condyl. inoculated by puncture	28	55
21	Von Bärensprung	Secretion from an induration inoculated by puncture	28	About 65.
22	"	Secretion from flat condyl. inoc. by puncture	28	Not stated.
23	Von Lindwurm	Secretion of indurated ulcer. puncture	15	About 2½ weeks.
24	"	Secret. of prim. affec. in No. 23. Two inoculations July 10 " 12	19 (29, VII.) 24 (5, VIII.)	About 5 weeks.
25	Hebra and Rosner	Secret. of flat condylomata upon the nipple	16	56
26	" "	" " "	21	52.
27	Pellizzari	Blood in scarifications	25	About 5 weeks.
28	Cullerier[2]	Pus of an indurated ulcer	38	33
29	Auzias Turenne	Secret. of flat condyl. upon vesicated spots produced by ammonia	18	Not stated.
30	" "	" " "	25	
31	Galligo (Florence)	Flat condylomata of the lips inoculated	17	"

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[1] The annexed figures are the numbers of the experiments in the original; they are given for the sake of more easily identifying the cases.

[2] The cases 28–31 cited by *Fournier*, l. c., p. 30–33.

The shortest period of incubation, according to this table, was ten days, which was, in fact, the only instance of an incubation of less than sixteen days. Most frequently the incubation lasted between fifteen and twenty-four days, in a small number of cases from twenty to thirty days, and only in four over thirty. The longest period of incubation was forty-four days.

In the cases not included in the table the period of incubation was usually stated at from three to four, or four weeks. Fournier collects from his clinical observations quite a large number of cases, which lead him to draw the inference that the period of incubation is oftener over than under three weeks; that not infrequently it is four, and is even six weeks sometimes; and he relates one case in which it is claimed to have amounted to seventy days. Von Sigmund[1] also states, that in a small number of cases he has observed a period of incubation of from forty-two to fifty-six days, while in the vast majority of cases it was over two and not over four weeks.

It is apparent from the above experiments that the locality of the body where the affection occurred had no influence upon the duration of the period of incubation, and examples enough are afforded in practice which go to show the same thing. Especially in the event of infection in unusual situations, as upon the lips, the breast, or in the vaccination-syphilis, it becomes possible often to fix the period of incubation with precision, and we then see that this period is, generally speaking, everywhere of a uniform length.

With regard to the circumstances which determine the duration of the incubation, we may infer from the experiments given in the foregoing table that they reside rather in the person infected than in the source from which the poison is derived, inasmuch as the period of incubation varies greatly when virus from one and the same source is inoculated upon different individuals (compare the cases seven to seventeen).

THE PRIMARY AFFECTION.

John Hunter, A Treatise on the Venereal Disease. London, 1786. Edited by J. F. Palmer. Lond., 1835, Vol. II.—*R. Carmichael*, An Essay on the Venereal Dis-

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[1] Wien. med. Wochensch., 1856, No. 77-80. *Auspitz*, S. 276.

cases which have been confounded with Syphilis. Dublin, 1814.—Clinical Lectures on Venereal Diseases, reported by *S. Gordon.* Dublin, 1842.—*Ph. Ricord*, Leçons sur le chancre, publiées par *Alfr. Fournier.* Paris, 1858. Second edition, 1860.—*A. Fournier*, Étude clinique sur l'induration syphilitique primitive. Archiv. génér. de Médecine, 1867, T. II. p. 503.—*De St. Germain*, De l'érosion chancreuse, rapport par Dolbeau. Soc. de Chirurgie, Gaz. des hôpit., 1867, p. 94.—*F. Hugenberger*, Ueber die primitive Erscheinung der Syphilis. Petersb. med. Zeitsch., B. XIV., 5, p. 290.—*G. Lewin*, Vorträge. Berlin. klin. Wochenschr., Febr., 1873.—*M. Kaposi*, Die Syphilis der Haut und der angrenzenden Schleimhäute. 1 Lieferung. Wien, 1873.

As a rule, the first manifestation of syphilis is, as already remarked, at the point where the poison gained access. Yet the literature of the subject embraces records of cases in which general syphilis, so to speak, broke out all at once without any local affection ever having been perceptible. The further our information extends with regard to uncommon seats of the infection, the rarer will such instances become; and in many cases we may assume positively that a primary lesion has not been discovered, simply because the examination was not circumspect enough, or not directed to the right places, or else because local signs which were present were not recognized as being really the primary affection. But since we have learned to avail ourselves of the indolent, glandular swellings as a guide to the situation of the primary lesion, not infrequently have we discovered the latter in places where we should least have expected it. Therefore, excepting the transmission of syphilis by inheritance, and from the fœtus to the mother, the possibility of syphilis occurring without a primary local lesion has become very dubious. Fournier declares himself opposed to the idea of the existence of a so-called "*syphilis d'emblée*,"[1] and he accounts for the cases which have been regarded as such, by supposing that, for some reason or other, their course in the commencement was either not recognized or not observed. Still the opposite view has many advocates, among whom H. Lee and Marston[2] may be named. Out of all the cases of experimental inoculation of syphilis upon healthy persons, made by the anonymous physician of the Palatinate

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[1] Leçons sur la Syphilis, p. 36.

[2] Med.-Chirurg. Transact., Vol. XIV. Cited by *H. Lee*, l. c., p. 425.

(who applied syphilitic blood to common ulcers of the leg in people otherwise healthy), local manifestations were wanting in but three cases where general syphilis followed. In these latter cases certain minute changes may still have taken place in the surfaces of the ulcers, which were not apparent to mere ocular inspection.

The first sign observed at the infected point in the experimental inoculations (which correspond in this particular with numerous observations where the contagion was effected in the ordinary way) is a circumscribed redness, and shortly afterwards an elevation of the spot into a *flat papule.* Inasmuch as the primary affection follows a somewhat different course upon the outer integument from what it does upon the mucous membrane, we shall first follow its development as illustrated upon the skin.

The papule which has been formed increases principally in the horizontal plane, it grows a little harder, and in from eight to ten days from the first appearance it begins to become a little scaly. In this condition, slowly increasing in size, and gradually becoming harder, it may continue for some length of time, or its centre becomes a little moist, and the slight amount of serum secreted dries into a crust. If this is removed, we find upon the surface, which is of a bright red color, and shining as if it were glazed, a very little pus, and when a moist dressing is applied to the papule, so as to prevent the crusting, the very scanty secretion is seen to consist of a gray, slimy deposit, adhering to the central portion of the papule, which is here of a livid color. By means of this superficial ulceration the middle of the tubercle becomes gradually excavated.

Exceptionally a more decided ulceration may take place, producing a crateriform ulcer. In individuals with bad constitutions, scrofulous persons, or in those much debilitated, in drunkards, and as a consequence of neglect or of injudicious and irritating treatment, gangrene sometimes ensues, and by this means not only the entire indurated tubercle, but the surrounding healthy tissues may become involved in a wide-spread destruction of tissue. More especially does this happen in that peculiar form of ulceration which we term *phagedæna.* The parts in the vicinity of such a phagedenic ulcer are greatly swollen and very red, and as the tissue destruction advances, its limits are defined by a sharp border. Besides, there is usually a great amount of pain present. Phagedæna, as a complication of the syphilitic, primary affection, is, upon the whole, rare, and certain observations of Hutchinson show that it is sometimes due to the infection of a syphilitic or chancrous ulcer with the poison of *hospital gangrene.*

The ulceration in most cases remaining quite superficial, the tubercle becomes gradually more and more indurated. This induration is sharply defined from the sound skin in its vicinity, and when its base is grasped between the fingers, it imparts the sensation of a hard disk, bevelled at its edges and set in the skin, or that of a more roundish, hard body.

If left to itself, the induration and superficial ulceration still continue to extend, and then sometimes remain in a certain condition for a considerable time before a process of resolution begins to make itself perceptible. The first signal of the latter is the disappearance of the livid hue, and the cleaning of the ulcerated surface, which little by little becomes covered with granulations and cicatrizes from the edges.

The course upon the *mucous membrane* is somewhat different, as, for example, upon the glans penis. In protected spots, as in the sulcus coronæ glandis, the first thing observed, after the period of incubation has passed, is a very small, itchy vesicle upon a reddened base, or an erosion, due to the bursting of the vesicle, which cannot be distinguished from the erosion resulting from a simple herpetic vesicle, such as often occurs upon the inner layer of the prepuce.

Such an erosion looks like a trifling affair, and many patients scarcely notice it, especially if some weeks have elapsed since the infection. Only anxious patients, who are in the habit of examining themselves critically, under these circumstances present themselves directly before a physician, and then we have an opportunity in a few days to see the small, superficial ulcer develop from the erosion, secreting a scanty amount of pus, and soon granulating. The place having granulated may cicatrize completely, and the induration gradually disappear; or else, and this is the case most commonly, the induration remains or continues to increase.

If such an induration is situated upon the glans penis, it is often perfectly flat, its hardness only being perceptible when it is grasped laterally, and resembles a piece of parchment (*indu-*

ration parcheminée of the French authors; Fournier terms the lightest grade of it, *induration foliacée* or *papyracée*). In these cases, occasionally, the immediate vicinity of the place assumes, in the course of a few days, a similar parchment-like thickening, which, however, disappears earlier than from the original spot. Such a parchment-like induration, or a simple flat, round, but still dry papule, may bear the closest resemblance to a papular syphilide of the secondary period, and they are, moreover, anatomically identical.

If the primary affection be situated in the sulcus, or just in the fold where the prepuce begins, the induration is usually of considerable magnitude and of a cartilaginous hardness; it also receives from the anatomical relations of the part some especial peculiarities. As the induration advances from the sulcus on to the inner layer of the prepuce, retraction becomes somewhat difficult; but when the prepuce is fully retracted, its posterior portion is tilted up, and the indurated place forms a projection which looks exactly like the posterior border of the tarsus of an everted upper eyelid. The top of this projection is perfectly bloodless, on account of the pressure to which the vessels are subjected by the eversion, and has the appearance of wax. The cartilaginous character of the induration becomes now very apparent.

If the induration involves the orifice of the prepuce, a phymosis is gradually produced as the hardening increases, and when the lips of the urethra have been the seat of infection, the entire end of the glans frequently becomes indurated, and a considerable contraction of the urethral orifice may be the result.

Occasionally, even when the ulceration has been slight, an acute *lymphangioitis* is developed upon the dorsum of the penis, accompanied by great swelling of the prepuce, and of the entire skin of the penis; it, however, usually recedes in a few days. This should be distinguished from induration of a lymphatic vessel between the primary affection and the nearest lymphatic glands, which is gradual in its occurrence, is usually nodulated, and occurs without inflammatory swelling or redness of the skin lying about it, and lasts for some weeks (see below).

These forms of the primary affection, just described, are observed likewise in *females*. But in the female genitals, simple *erosions*, which patients hardly notice, with parchment-like thickening, are of more common occurrence than real tubercular indurations. The thickening may be tolerably extensive upon the edges of the labia minora, or upon the præputium clitoridis. The small and slightly indurated erosions have often but a brief duration. But the parchment-like, at first dry, indurations upon the edges of the labia minora, or isolated papules upon the inner surfaces of the labia majora, where the mucous membrane is kept moist through opposite surfaces lying in contact with each other, or where the parts are constantly moistened and irritated by pathological secretions from the uterus and vagina (such as are commonly present under these circumstances), soon assume another character, and are gradually transformed into moist hyperplastic growths—the condylomata lata.

As illustrated in a case of Von Lindwurm's,[1] the primary affection in men may also, though rarely, take the form of a flat condyloma. But this must not be confounded with an *ulcus elevatum*, that is, with exuberant granulations upon a simple ulcer (chancre). One might fall into the error, in such a case, of supposing that a simple ulcer—a "chancre"—had been transformed into a symptom of syphilis, viz., into a flat condyloma.

In women the primary affection has its seat most commonly on the labia majora and minora, or in the posterior commissure, *extremely seldom in the vagina*, though not infrequently in the portio vaginalis.

With regard to the occurrence of the syphilitic primary affection *in other parts of the body*, we still find its main characters to be papular development, and especially, under all circumstances, the characteristic induration, whether it be the lips or cheeks, infected in kissing, or the fingers of a physician or midwife infected in a labor case. Upon the lower lip the primary affection usually occurs in the form of an indurated fissure, particularly if its seat is in the middle of the lip.

Usually there is *but one place* which can be regarded as the primary affection; but in the event of the poison having gained access at several points, there may be two or more such places; and this is especially apt to be the case in women.

The limitation of the syphilitic primary affection to the point of the original infection essentially distinguishes it from the simple chancrous ulcers in which multiplicity is almost the rule; for in these ulcers other places become infected by contact, and by reason of the short time required for a chancre to develop, they attain their complete development almost as soon as the original sore.

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[1] L. c., p. 162.

The syphilitic primary lesion *leaves a scar* only when the rete Malpighii or the layers of the cutis or mucous membrane have been destroyed. In the one case there remains only a pigmentless spot; in the other, a true cicatrix. If there has been merely a thin parchment induration in the mucous membrane, in the female genitals more especially, every trace of it may be gone within a few weeks. Upon the collum uteri particularly, as stated by Fournier, the primary affection often heals with surprising rapidity.

The variations presented by the primary affection—differences in form, degree of induration, and extent of ulceration—depend far more upon the seat of the affection and upon such accidental influences as its scabbing over, the irritation of caustics and illy-applied dressings, and upon the patient's constitution, than upon the nature of the affection itself.

The first appearance and development of the primary affection does not always answer to the description as given above. Although in private practice, and in persons who expose themselves but seldom to the risk of infection, we sometimes see the disease follow what may be called its normal course, we meet with cases in the hospitals, and particularly amongst the nymphs of Venus vulgivaga, as well as in the laboring classes, which differ from the above in this essential point, viz., that, according to the statements of the patients, the disease appears often but a few days only after the infection. But a day or two, as they say, after an exposure, a small vesicle perhaps appeared, which in a few days became an ulcer, and in a few more other such ulcers made their appearance in the vicinity or upon parts lying adjacent.

In men, if sores form upon the prepuce or glands, it soon becomes impossible to retract the foreskin. It is then, not uncommonly, that medical aid is first sought. Under such circumstances we find the prepuce œdematous and greatly swollen, and through the swelling a considerable circumscribed hardness may be felt. If the prepuce is divided, so as to lay bare the glans penis, a large, deep ulcer, with hard base, appears in the sulcus, encroaching upon the mucous membrane of the prepuce, and which, if kept clean, soon begins to granulate, although its hardness still continues.

When an opportunity is afforded to observe such a case from the commencement, it is seen that from a slight tear of the mucous membrane, sustained during coition, or, such not being perceptible, from a vesicle appearing a few days later, an ulcer develops, with sharp-cut edges and surrounded by an inflammatory areola. The ulcer increases in circumference and depth, and when the purulent secretion is wiped away, displays a gray, unhealthy base. This ulcer has received, on account of its corroding character, the name of "*chancre*" (from cancer). Its edges and base are usually soft. *If the pus from this chancre is inoculated upon a healthy person*, *or upon the bearer*, *there results*, *in twenty-four hours*, *a small pustule*, which forthwith turns into another chancre, with likewise inoculable secretion. After it has lasted for three or four weeks a perceptible induration of the base appears, and, as this increases, the sore begins rapidly to granulate and cicatrize, unless through appropriate treatment it has not already healed before, in which later case the induration develops in the scar. This induration is the specific mark of the primary affection, both when it follows this course and in the other case described above. This fact was pointed out, more especially by Hunter,[1] although he was not the first to do so, and since Ricord's time this induration has been commonly known as the "*Hunterian induration.*"

The induration of the syphilitic primary affection was perfectly well known even to the writers on syphilis in the fifteenth and sixteenth centuries. Thus in a poem on the disease by the Spanish physician, F. Lopez de Villalobos[2] (1498), we find especial mention made of the *hardness* of the ulcer. J. de Vigo[1] (1503) speaks of pustules, "*cum callositate eas circumdante*," and Petrus Maynardus[2] (1506) of "*pustulæ induratæ*." But the following passage by Gabr. Fallopia[3] (1564) is especially noteworthy: "Suboriuntur ulcuscula in pudendis callosa, vel fiunt callosa quæ inceperant. Quoties videtis sanatam cariem et quod remanent calli circa cicatricem, tenete esse confirmatum Gallicum, . . . quoniam calli illi sunt manifestissima et demonstrantia signa morbi confirmati." Hence we might with as much propriety speak of the *Fallopian induration* as of the *Hunterian*.

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[1] L. c., p. 316: "A chancre has commonly a thickened base, and although in some the inflammation spreads much further, yet the specific is confined to this base," p. 320 : . . . "but still there is a hardness peculiar to this poison surrounding the sores, especially those upon the prepuce."

[2] "Mas quando en tal miembro esta buba óllaguita (wound) majormente si es sin dolor y esta *dura.*" The Medical Works of *Francisco Lopez de Villalobos*, translated by *G. Gaskoin.* London, 1870, and Med. Times, l. c., p. 200.

Until within the last ten years, the course of the disease which has just been described—namely, *ulceration commencing a few days after the infection, and later induration of the ulcer*—was supposed by the majority of physicians, mainly under the influence of Ricord's authority, to be the ordinary course, or, so to speak, the *normal* one.

We see how much biassed opinion and the reverence for authority hindered ingenuous inquiry, when we reflect that not only in this century have unprejudiced observers like G. Babington shown the induration to be the most essential part of the primary affection, and that it often precedes ulceration, but physicians even in the sixteenth century, as was known by Hunter[4] too, were perfectly well aware that the syphilitic primary lesion often made its appearance only after a considerable period of incubation. In this connection the following passage from Hieronymus Capivaccius[5] is very interesting: "Quibusdam simulac venere sunt usi eo ipso die caries erumpit; nonnulli post coitum non corripiuntur carie nisi post 30 aut 40 dies." So C. was well aware of the period of incubation in syphilis, and distinguished the two courses pursued by the primary affection described above, while Ricord still, in 1851, made the induration begin in three days, as a minimum, and invariably in the course of the first or second week, and declared the opposite views, viz., that the induration may precede ulceration, and that sometimes the chancre does not become indurated before the third or fourth week of its existence, to be erroneous. Ricord came to these conclusions mainly through his experimental inoculations; but inasmuch as these were only made upon the bearers and not upon healthy subjects, they became, of course, the source of false inferences, not only with reference to the primary affection but with regard to the question of the inoculability of the syphilitic secondary lesions.

According to Ricord's earlier representations the induration of a chancre appeared as a constant occurrence in the course of all venereal sores of the genital organs. But in his letters, published in 1850–1, a division of the chancres was made into such as become indurated and those that do not, and to the former only was ascribed the power of infecting the entire body, that is, of causing general syphilis. As to which of these alternatives should take place was referred to pure chance. It was supposed to depend mostly upon the character of the soil in which the ulcer develops, that is, upon peculiarities in the individual infected. Thus was the first step taken towards founding the doctrine of duality in syphilis—in other words, towards the theory that syphilis and chancre owe their origin to distinct morbid poisons.

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[1] Aphrod., I. p. 450.

[2] Ibid., p. 392.

[3] Ibid., II. p. 781; see also *Auspitz*, l. c., p. 30.

[4] L. c., p. 319.

[5] L. c., p. 20.

The Doctrines of the Unity and Duality of the Syphilitic and Chancre Poisons.

Ph. Ricord, Traité prat. des malad. vénér., recherches crit. et expérimen. sur l'inoculation. Paris, 1838.—Lettres sur la Syphilis. Union Médicale, 1851, 1852, 2d ed. Paris, 1856.—Leçons sur le chancre, redig. par *A. Fournier*. Paris, 1858. 2d ed., 1860.—*Leon Bassereau*, Traité des affections de la peau, symptomatiques de la Syphilis. Paris, 1852.—*Clerc*, Du chancroide syphilitique (Moniteur des Hôpitaux). Paris, 1854.—*Cullerier*, Rapports à la Société de Chirurgie. Bulletins, 1855–57.—*M. A. Dron*, Du double virus syphilitique. Thèse de Paris, 1856.—*V. de Méric*, On the Unicity or Duality of the Virus in Syphilis. Lancet, Aug. 21, 1858.—*Diday*, Exposition critique et pratique des nouvelles doctrines sur la Syphilis. Paris, 1858.—*Rollet*, De la pluralité des maladies vénér., 1858. Études sur le chancre produit par la contagion de la Syphilis secondaire. Archiv. génér. de Méd., Febr., 1859. Recherches clin. et expérim. sur la Syphilis, etc. Paris et Lyon, 1861.—*Von Bärensprung*, Annalen des Charitékrankenhauses, 1860.—*Von Lindwurm*, Würzb. med. Zeitsch., 1862, B. III., S. 146.—*Von Sigmund*, Ueber Verschiedenheit der Ansteckungsstoffe, etc. Wiener med. Jahrb., 1861. H. IV. and numerous articles in the different Vienna medical journals of the years 1860–70.—*F. E. Friedrich*, Ueber die Lehren vom Schanker. Erlangen, 1861.—*W. Boeck*, Recherches sur la Syphilis. Christiania, 1862.—*H. Köbner*, Klin. u. experim. Mittheilungen aus der Dermatologie und Syphilidologie. Erlangen, 1864.—*H. Auspitz*, Die Lehren vom syphilit. Contagium. Wien, 1866.—*J. Cooper Forster*, Syphilis and Chancre. Guy's Hospital Reports, Series III., Vol. XV., 1869, p. 159.—*J. Morgan*, On the Nature of the Vener. Poison. Med. Press and Circular, 1871. Brit. Med. Jour., 1871, Vol. I. p. 94.—*F. J. Bumstead,* On the Present State of the Question of the Unity or Duality of Syphilis. Amer. Jour. of Med. Sciences, April, 1873, p. 321.—*M. Kaposi,* l. c.

It was Leon Bassereau, a pupil of Ricord, who, in 1852, treading in the footsteps of his master, and dividing the chancres into two varieties, the hard and the soft, as Ricord had done, first made the division complete with respect not to their form merely but to the sources from which they spring. Having made inquiry in a large number of cases of venereal disease as to the source from which the infection was derived, he ascertained that in every instance patients who had hard sores traced their infection to persons who were syphilitic, that is, who still bore evidences of primary or secondary disease; while sores that remained local—simple chancres—only produced their like when transmitted; in other words, only produced sores which remained permanently local, with or without suppurating buboes.

The new doctrine soon met with support founded on fact, especially from Clerc. But it was Ricord again who, in his lectures on chancre in 1858, through the weight of his authority and by his brilliant eloquence, secured approval for the new doctrine and gave it currency. Ricord had meantime learned to distinguish the inflammatory hardness of a chancre from the specific hardness of a syphilitic induration. He had likewise abandoned the idea of the unity of the two kinds of sores, and accepted the doctrine of Bassereau, in so far as to adopt the principle that *each variety of sore propagates only its own kind;* the soft chancre operating upon all alike, both healthy and syphilitic, but the hard syphilitic sore only upon the healthy. For both he and Hunter had established the fact, by experimental inoculation, that the secretion of the syphilitic hard sore is not inoculable upon the bearer nor upon others already syphilitic.

Meantime the doctrine had received material support from numerous inoculations of syphilis upon healthy subjects (see p. 42 et seq.), inasmuch as in the great majority of these inoculations it was shown that a period of incubation of some weeks occurs before the appearance of the primary affection. On the other hand, the numerous inoculations of Ricord and others, with the secretion of soft chancres, had shown that in twenty-four hours a redness appears, and on the third day a vesicle, which in a few days more turns into an ulcer. Therefore it could no longer be supposed, with Ricord, that infection with the syphilitic virus is always followed a few days after by a chancre. *The syphilitic poison has a period of incubation, the chancre poison has not.*

But in order to account for cases occurring in practice, where, a few days after an infection, a sore is formed, with all the characteristics of a chancre, but which after the lapse of a certain time, begins to become indurated, and is followed by general syphilis, the hypothesis of Rollet (1858) became necessary, namely, that different poisons may be inoculated simultaneously, and will be followed by a complex result. Thus gonorrhœa and chancre may coexist in the same individual, and both be transmitted together, and so, also, with chancre and syphilis. If in the latter case both poisons are transmitted at the same point, *a mixed chancre* is the result, that is, there is developed first a chancre, and after a time, sometimes not until the sore has healed, an induration takes place.

In another way, too, may the action of both poisons be evinced at the same point of the body, as, for instance, where chancre virus is inoculated upon an existing syphilitic induration. This has been demonstrated experimentally by Laroyenne, Basset, Melchior Robert, and others with positive results.[1] The converse of this, viz., inoculation of syphilitic poison upon a soft chancre, is likewise possible; but practically the occasions for its occurrence must be extremely rare, inasmuch as persons who have soft chancres are not so ready to expose themselves to another infection as those with syphilitic indurations which cause but slight annoyance.

An important question is, whether from such a mixed sore, following a double infection, it is possible to produce by inoculation upon a healthy person another sore with the same mixed characters? The possibility of transmitting both poisons simultaneously was demonstrated in an experiment by Hebra,[2] which, however, was not entirely satisfactory, for the reason that blood was inoculated together with the secretion from the sore. Therefore it really does not prove that both poisons were contained in the secretion, and in this respect is analogous to a number of the observations made with regard to vaccination which have been already cited.

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[1] *Lancereaux*, l. c., p. 74.

[2] *Auspitz*, l. c., p. 227.

Secretion from a soft chancre was inoculated upon tubercles about the size of peas, which were scattered over the body of a syphilitic patient. Ulcers formed, and from this secretion, mingled with blood, another person was inoculated. Two days later, pustules appeared at the places inoculated, which turned into ulcers, one of them healing in four weeks, while the other grew larger and became indurated. Subsequently symptoms of general syphilis appeared. (Compare also Case II., on page 95).

In Germany, through the researches of Waller and others, the way had already been prepared for the new doctrine, and it therefore soon found adherents, among whom von Bärensprung gave it a more precise interpretation, in transferring the essential ground of distinction from the difference in the forms of the sores to a difference in the poisons to which the sores are due.

In the study of these questions the mistake has always been made of generalizing too hastily, and this criticism applies especially to Ricord. Thus, certain points were laid down by him as characteristic of the syphilitic primary affection, which failed to bear the test of further experience, and the same thing happened again in regard to the separation of the soft chancre from the syphilitic indurated sore. Not only was undue weight laid upon certain signs, whose recognition was always more or less dependent upon the subjective appreciation of the observer, as in deciding between the hardness or softness of a particular ulcer, but other characteristics were affirmed of the ulcers with too great positiveness, and from inadequate observations. In this category belongs the assertion, dating from an earlier period of Ricord's teachings, that a soft chancre never occurs upon the head, or, in other words, an infection upon the head is always followed by an induration.[1] This question elicited considerable controversy, but was first answered by means of experiment by Rollet, in 1857, and by some others later, and since then by means of numerous clinical observations, the import of this testimony being that the head possesses no immunity with regard to the soft chancre, the rarity of its occurrence in this situation being solely due to the infrequency of the occasions for transmitting chancre poison to this part, while indurations may be often produced upon the head in consequence of the transmission of syphilitic poison, from secondary lesions upon the mouth, usually in the act of kissing.

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[1] *Auspitz*, l. c., p. 108. *Lancereaux*, l. c., p. 81.

On the other hand, the opponents of dualism have thought that because a single such position had been successfully attacked, the whole doctrine might be overthrown in the same way.

The principal point against which the attacks upon the doctrine of dualism are concentrated is the proposition *that each kind of sore propagates only its own kind.* The results of confrontations and experiments are adduced in opposition to this. Clinical experiences are called in, with instances where frequently nothing but soft chancres were found as the source of characteristic indurations. Quite recently J. Morgan[1] called attention to the fact that in the Westmoreland Lock Hospital a hard sore was scarcely ever observed in the female patients, while in the men, who had been infected from this same class of women, such sores were by no means rare, and that in certain cases, where the infection could be traced directly to its source, he had found a hard sore in the man and a soft sore in the woman. We shall take occasion later (compare page 114) to refer again to this point, as well as to the statement, often made, that in a given instance constitutional syphilis has succeeded to an undoubtedly soft chancre. For the present we proceed at once to those objections which the opponents of dualism derive from the results of experimental inoculations. These objections are comprised in the following propositions, viz., that by means of experiments in which the secretions of indurated sores and flat condylomata were inoculated, it has been proven that the syphilitic virus,

1. Contrary to the assertions of Ricord and von Bärensprung, is inoculable both upon *the bearer* and upon *others*

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[1] Brit. Med. Journ., 1871, Vol. I. p. 94.

syphilitic; but in this case, almost without exception, *a soft chancre* with all its characteristic marks—absence of incubation and inoculability in generations—will be produced; and,

2. That in rare cases, when inoculated upon *healthy subjects*, it has immediately produced a soft chancre both with and without subsequent syphilis.

1. The non-inoculability of the syphilitic indurated sore upon the bearer or upon other syphilitic subjects was regarded for a time as a cardinal point of distinction between this sore and the soft chancre. Then, in consequence of Clerc's researches,[1] some exceptions to this rule were learned. In inoculating the secretion of an indurated sore upon the bearer, Clerc obtained a positive result in producing not an indurated but a soft sore. From this experiment, joined to another observation where a typical indurated sore, situated upon the scrotum and afterwards followed by a papular syphilide, caused the production of a soft sore upon the skin of the penis lying in contact with it, Clerc concluded that the pure, soft chancre is, in fact, the result of inoculation from an infecting sore, that is, the effect of the syphilitic virus upon an individual already syphilitic. By virtue of the immunity conferred by the disease, a syphilitic person did not acquire an indurated sore from a second inoculation of the virus; but, if the inoculation took at all, only a soft chancre, to which Clerc, as Maratray had done before him, gave the name of "*chancroid.*" This stands in the same relation to the infecting sore as the varioloid to variola, or the abortive to the typical vaccine pustules.

Although these observations (to which belongs one made by Fournier[2] in 1856, who made such an inoculation with positive result) were somewhat isolated, yet their numbers were increased as soon as certain experimenters succeeded in exciting syphilitic indurations to a copious secretion of pus by artificial means. Henry Lee[3] used for this purpose savine ointment, and with the pus produced under its irritation he and others (Melchior Robert, in Marseilles,[1] for example) succeeded in producing upon the bearers of indurations, without incubation, ulcers which bore the characters of soft chancres, and were further inoculable. Köbner[2] obtained a like result by inoculating the secretion of flat condylomata which had been irritated with savine ointment or powder. These investigators, therefore, succeeded in making the syphilitic virus auto-inoculable. The greatest number of inoculations of secretion from indurated sores was performed by Boeck and Bidenkap[3] in Christiania, who, in their recent attempts at curative syphilization, employed only the secretion of indurated ulcers.

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[1] L. c., in *Auspitz*, p. 104.

[2] *Auspitz*, l. c., p. 113.

[3] Brit. and Foreign Med.-Chir. Review, 1859. The Lancet, 1856, 1859–61. *Auspitz*, p. 310 et seq.

In the above experiments the secretion of soft chancres did not come into play at all, but solely the, in some way, augmented secretion of syphilitic primary lesions, or of later local affections, as flat condylomata or tubercles, in which, by means of savine ointment, or even by mechanical irritation, as by a seton (Pick[4]), a profuse suppuration had been induced. Can we thence infer that it was the *syphilitic virus* in these cases that produced the soft chancres, which were, inoculable in generations? Certainly not. For, in the first place, in this secretion produced by irritation, we have to do with a very complex product, which can by no means be regarded as identical with the syphilitic poison. It may, in many instances, contain the syphilitc virus, but its chief component is pus. In the second place, there are a number of facts that go to show that the secretion of a syphilitic local affection is not at all necessary to the production, upon a normally appearing portion of skin in a syphilitic subject, of a sore which is inoculable in a series of generations.

It has been shown, namely, that perfectly ordinary, non-specific pus, inoculated upon syphilitic subjects, causes soft ulcers which may also be inoculated in generations. At Zeissl's suggestion, Pick[1] inoculated pus from scabies, pemphigus, and acne pustules (which pus, when inculated upon the bearers of these affections or other non-syphilitic persons, gave a negative result) upon syphilitic subjects, with the result of producing soft sores from which still other inoculations could be made. Kraus and Reder obtained with the pus of scabies, and Henry Lee[2] with pus from a non-syphilitic child, the same result. Therefore it appears that the skin of syphilitic individuals possesses a marked vulnerability, a peculiar aptitude to become inflamed when acted upon by irritants. We find this peculiarity, too, in many individuals who are not syphilitic. Every physician has met with such persons, in whom the most trifling injury results in suppuration. Moreover, this susceptibility of the skin to irritation is by no means uniform in syphilitic subjects (Berkeley Hill,[3] Bidenkap). It remains to be seen if in the syphilitic subjects manifesting this disposition, a more simple irritation, continued for some length of time, as the introduction of clean needles, for instance, or electricity, is not likewise capable of producing sores similar to the soft chancre.

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[1] *Melch. Robert*, Nouv. traité des mal. vén., 2 ed. Paris, 1861. *Auspitz*, p. 315.

[2] L. c., p. 77.

[3] *Auspitz*, l. c., pp. 239, 325.

[4] *Auspitz*, l. c., p. 335.

Here evidently belong the results obtained by Michaelis,[4] by cauterization of "*indolent buboes*" with Landolfi's caustic paste, and inoculation of the pus formed after separation of the slough. *Pustules followed without a period of incubation.* Only one of those so treated became undoubtedly syphilitic, that is, had secondary symptoms. In this instance the communication of the pus to a healthy subject might possibly have produced a mixed result.

The last-mentioned experiments did much to deprive the virus of the soft chancre of its alleged specific character. But there still remained the notion that there must be a syphilitic soil for it to originate in, ulceration having been first excited in the former by means of the inoculation of various purulent secretions. But quite recently Kaposi[5] has published certain investigations, the results of which divest the soft chancre of its specific character completely, and, should they be substantially confirmed hereafter, the doctrine of the identity of the syphilitic and chancre poisons, or even of a relationship between them, will lose its principal support. Kaposi says:

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[1] *Zeissl*, Lehrbuch, B. I. p. 176.

[2] Med.-Chir. Transactions, 1867. *Lancereaux*, p. 88.

[3] L. c., p. 256.

[4] *Auspitz*, l. c., p. 307.

[5] L. c., pp. 47 and 57.

> "My own experiments have taught me that non-syphilitic pus, such as we find in acne and scabies pustules in non-syphilitic persons, when inoculated upon the bearer, as well as upon other non-syphilitic persons, produces pustules whose pus proves to be inoculable in generations; that loss of substance was caused by the pustules, which healed by cicatrization, and that with the increase in the number of pustules produced by the inoculations the contagiousness of the pus diminished, and finally became quite extinguished."

These non-specific inoculated ulcers had therefore all the characters of the soft chancre. Kaposi's results, which go far beyond those obtained by Pick, are analogous to the results which L. Vidal[1] has recently obtained, in inoculating pus from ecthyma pustules in typhoid fever and ecthyma simplex. This pus was found to be auto-inoculable, and that, too, in three or four generations of pustules; but it was not inoculable upon healthy persons, only upon the bearers.

So long as its corroding character and the inoculability in generations are accepted as the decisive characteristics of the chancre, we must admit the ulcers produced by Clerc, Lee, Boeck, as well as now those of Pick and Kaposi, to have been soft chancres. The necessary conclusion then, is, that the *poison of the soft chancre may, under certain circumstances, be produced de novo without the intervention of the syphilitic virus*, while the syphilitic poison propagates itself only in one continued series. Hence the chancre poison, or whatever in the above experiments produced the chancre-like pustules, cannot even be compared with the syphilitic poison, to say nothing of regarding them as identical. As implied in what has been already said, and as was assumed by Rollet, and confirmed through experiments by Köbner,[2] it is the pus to which the irritant property that generates the ulceration pertains; and according to the source and mode of its origin, as well as according to the susceptibility of the individual affected, will the pus possess and evince this property in greater or less degree. Whence the pus derives this property, in what it consists, and why all pus does not possess it alike, are questions not yet solved.

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[1] Annales de Dermatologie, 1873, No. 5. Ref. in Gazette hebdomad., 1873, No. 45.

[2] L. c., p. 86 et seq

Whether the soft sores which can be produced in syphilitic persons, either by means of true syphilitic secretions (to which belong purulent vaginal secretions in syphilitic subjects, according to John Morgan) or by means of non-specific pus—in other words, whether *the chancroid of Clerc, when communicated to a healthy person*, is capable of producing syphilis, or only local sores which remain soft and are further inoculable, has not been positively determined. Up to the present time but two experimental observations have been made with regard to this point, and these with contrary results. They are described by Bidenkap,[1] and are the following:

Case I.—A young woman, admitted for vaginal and urethral blennorrhœa, Oct. 9, 1862, out of curiosity inoculated herself by means of a needle with the pus from artificial sores in a patient who was being treated by syphilization. These artificial sores sprang originally, though conducted through many generations since, from an infecting sore which had been inoculated by Bidenkap.

A few days after the inoculation, according to the patient's statement, there resulted a pustule, which turned afterwards into an ulcer that lasted for two months. This produced another in its vicinity; both healed without leaving indurated scars or enlarged glands, and were not followed by constitutional syphilis. One and a half years later she acquired syphilis through a fresh sore upon the genitals, which was obtained in the usual way.

Case II.—A young woman, affected with eczema of the forearm, who had never suffered from venereal affections, inoculated herself, like the previous patient, out of caprice, with eighteen chancres, to which were added, since the manner of their origin was at first uncertain, twelve others, inoculated from the first, in order to test their character. The sores from which she had inoculated herself likewise sprang originally from the secretion of infecting sores, which secretion, however, had passed through many generations and individuals.

The pustules became transformed into tolerably large ulcers. Two of them felt somewhat hard, but in most of them there was not a trace of induration. At a little distance from certain of the sores, a small, somewhat tender glandular enlargement could be felt. January 27th. All the ulcers healing. Two of the largest were seated upon a hardish swelling, which was pretty well defined, and felt like the half of a little sphere. Four others were somewhat hard, but their hardness was not so sharply defined.

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[1] Wiener med. Wochenschr., 1865, No. 34. *Auspitz*, l. c., p. 236.

February 17th. Slight symptoms of fever appeared, and there was redness of the fauces, with whitish exudation upon the left tonsil and over a part of the velum. She was ordered, internally, chlorate of potash, and in a few days all the symptoms had disappeared. The exudation upon the tonsil reappeared several times, but always went away again without treatment. At the end of February and the beginning of March she had some derangement of digestion and hysterical symptoms; meantime the ulcers healed and left behind bluish or brownish scars; those of the two most markedly indurated ulcers were somewhat hard.

April 23d. In the right axilla a swollen gland could be felt, as large as a hazel-nut, which was hard, movable, and not tender. April 24th there appeared upon the abdomen several isolated pustules, as large as a flax-seed, with red areola. Besides these, no other symptoms of syphilis. On the 29th the pustules had increased in size and number; the largest were nearly the size of peas, with depressed centre, and the region about was bluish and somewhat swollen. One or two glands were also perceptible. Inoculations from the pustules gave a negative result. Several more of them appeared upon the back and breast, and she complained of headache, especially towards evening. In the course of some days these symptoms vanished, the pustules dried up, and the patient appeared quite well.

One month later, that is, five months after the inoculation, as no new symptoms appeared she was discharged as recovered.

Now in the first of these cases the result of the inoculation was simply local; in the second, however, the course was exactly what it would have been after the inoculation of two poisons; that is, what is required by the hypothesis of the mixed chancre. Induration followed the ulceration, which began at once, without a period of incubation, and later came the general syphilis. The physicians who observed the symptoms developed—Boeck and Bidenkap—did not regard them as syphilitic.[1] Köbner, on the other hand, also an opponent of dualism, recognizes them as such unconditionally.[2]

But the statement that the syphilitic sore is not inoculable upon the bearer, has been subjected to a still further qualification. Not only have *soft chancres* been produced in inoculation experiments upon syphilitic persons, but in some instances the inoculation of syphilitic secretions upon a syphilitic subject

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[1] *Auspitz*, l. c., p. 239.

[2] L. c., p. 77.

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has been *followed by the development of a papule, after the lapse of a considerable (from three to four weeks) period of incubation.*

The cases which bear upon this point were all observed by Bidenkap[1] and Boeck. They are the following:

Case I.—O. C., who had never before had constitutional syphilis, came into the hospital on the 26th of August, 1861, with a slightly indurated ulcer upon the orifice of the urethra and two erosions upon the left labium. From the ulcer in the commissure the skin of the thigh was artificially inoculated. For the first fourteen days nothing further was noticed at the inoculated place, and consequently no further examination was made of the patient until the 27th of September. There now appeared at the point inoculated an ulcer of the size and shape of a split almond, which was seated upon a deep and extensive induration. This had therefore taken fourteen days at least to develop, and, according to the patient's statement, nearly three weeks. The ulcer having healed, the patient was discharged upon the 14th of October, but returned February 22d, 1862, with the symptoms of constitutional syphilis.

Case II.—J. S. entered the hospital January 3d, 1863, with an eroded well-marked induration in the retropreputial fold, slight swelling of the inguinal glands, but presenting otherwise no symptom of syphilis. The disease had been contracted towards the middle of December, and the girl, from whom he acquired it, was admitted into the hospital December 10th, 1862, with moist papules upon the genitals. On the 9th, 10th, and 11th of January, inoculations were made upon the side of the thorax, with the secretion of the chancre, but without any immediate effect.

January 12th, pulv. sabinæ was strewn upon the chancre, and by this means in a few days a copious suppuration was induced. The pus thus obtained being inoculated in the left side of the thorax, caused, at first, only little pustules, which soon dried up; but, January 17th, an inoculation made from this pus produced a large pustule surrounded with a red areola, which in a few days turned into an ulcer. An inoculation performed on the 24th of January had the same result. February 5th. "The artificial ulcers are healing. At the places where inoculations were made upon the 9th January, and the days following, only pale red papules are to be seen. At the place that was inoculated upon the 9th, the papules are of the size of a pea, at the other places smaller. At those made on the 12th they are the size of pin-heads. These papules were seated regularly in threes, at the points inoculated, and at places even where it was supposed the inoculation had failed. The papules increased daily in size, became more prominent, were surrounded by a red areola, were themselves of a more livid color, and finally showed at the top a commencing desquamation."

On the 9th of February a small, movable, hard, not tender gland was discovered above the largest of the papules mentioned. The 11th of February a slight roseola; later, moist papules on the scrotum and erosions in the mucous membrane of the pharynx. Expectant treatment.

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[1] Wiener med. Wochenschrift, 1865, Nos. 31–34. *Auspitz*, p. 321.

"For some weeks the papules increased in size, the scabs became thicker, and on the 22d of February the oldest were covered with a thick, reddish-brown scab, which, upon being removed, revealed a dark red, slightly moist surface. April 22d. The scabs had fallen off and the papules were somewhat flatter and of a browner color. The longest had a diameter of from three to four lines. From the indolent glandular swelling in the right side of the thorax, a hard cord could be distinctly felt extending upwards to the next gland, which was likewise enlarged, and from this another cord led as far as to the axilla, where it was lost in a large, somewhat movable glandular swelling. Brown-colored spots were left by the papules.

Case III.—A. A. was admitted January 5th, 1863, with a sore on the collum glandis, seated upon a cartilaginous induration. In both inguinal regions, but especially the right, hard, swollen glands. Infection about five weeks before; according to patient's statement, there were small erosions in the situation of the sore eight days before. With the scanty, thin transparent secretion which could be scraped from the moist surface, inoculations were made upon the thorax on the 9th of January, and every second day afterwards. January 25th, as no effect was observed at the inoculated places, pulv. sabinæ was strewn upon the ulcer, and the purulent secretion thereby produced was inoculated upon the arm, which caused, upon the 29th of January, characteristic pustules, which were inoculable in ten generations upon the bearer and other patients.

"In the last few days pale-red papules had made their appearance at the places first inoculated, those, namely, from the 9th to the 13th of January. On the 29th those inoculated upon the 9th of January had reached a diameter of two lines. On the same day, traces of a commencing roseola were observed. The cervical glands were also enlarged."

February 3d. Papules were forming at all of the points inoculated. They followed the same course as in the preceding case. The resolution began towards the end of March. On the 5th of March, the patient was attacked by a diffuse erysipelas, which proceeded from one of the artificial chancres upon the left arm. During this intercurrent affection, which lasted one week, all the artificial sores dried up, the papules became even with the surface of the skin, and looked finally like brown maculæ. Afterwards, when the erysipelas had disappeared, the papules became again elevated.

"April 22. The following was noted: For several weeks the indolent glandular swellings have been perceptible along the border of the mus. pector. major.—At one point the connecting lymphatic vessel can be felt as a hard cord. In the axillæ, groups of similar enlarged glands are felt."

Case IV.[1]—P. A. F. entered the hospital February 22d, 1867, with an indurated sore of the corona glandis. Inoculations made with pus, obtained by sprinkling savine powder over the ulcer. March 23d. No effect yet observed. March 25th. Roseola. May 23d. At the point of the test inoculations eight papular elevations of a brownish-red color, and desquamating. How long they had been there cannot be stated, since the places had not been examined for some time. June 17th, they had disappeared.

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[1] *W. Boeck*, Ueber syph. Infectionsweisen, etc. Archiv für Dermatol. und Syphilis, I., 1869, 2, p. 177.

Case V.—A patient had connection for the last time six weeks before admission to the hospital, and a few days before his entrance (October 3d), had noticed a small excoriation upon the glans penis, and inner surface of the prepuce. Induration not perceptible. Inguinal glands on the left side somewhat swollen. Inoculations were made, sometimes daily, sometimes on alternate days, but did not appear to take. November 2d. Marked induration and profuse suppuration. Inoculation of the pus upon the bearer, as well as upon other syphilitic subjects, caused, in two days, typical pustules. *Beginning of November*, *roseola.* "At the same time the red spots on the breast, which had remained from the inoculations of the first three weeks, which appeared to have failed, having meantime somewhat increased in area, began to rise above the skin and rapidly developed into papules, or rather into tubercular elevations of a bright red color, and as large as small peas. The largest had developed from the oldest inoculations, made at the beginning of October."

Besides these, several other such cases have been observed in the last few years at Christiania, and some of them are briefly reported by Boeck.[1] In two cases the course was exactly like that in those which we have given in detail; in a third there was this difference—that the patient had already, when the inoculations were begun, tubercula mucosa genitalium et ani. In this instance, also, *papules* were formed in the situation of the inoculations; *but these inoculations were not made with the secretion of the indurated chancre, but from a pustule* which had been produced by inoculation of its secretion. Moreover, the case is not very fully or clearly reported, particularly with regard to the chronology; it is not stated whether or when the roseola appeared, and with regard to the "papules" mentioned, it is remarkable to see the statement made that reinoculations were made from these. The case is in many respects, therefore, unique.

We shall recur to these very important cases elsewhere; for the present let them merely serve to show that real syphilitic virus, that is, the scanty, thin, transparent secretion of an induration, when inoculated upon the bearer, has really a quite different effect from that produced by the abundant purulent discharge which is excited in the sore by means of artificial or other irritation. These cases also show the rashness of denying absolutely the proposition that the syphilitic poison is inoculable upon a subject who already has a syphilitic sore, or, as Ricord calls it, an "infecting chancre," in other words, denying that there may be a *multiple* syphilitic primary affection. It should be well observed that, with a single exception, in all those cases in which a second inoculation of the virus produced its usual effect after the syphilitic primary affection had already been developed, this inoculation was made before the disease had progressed so far as to involve the whole organism. In not one of the more carefully reported cases had a longer period than six weeks elapsed from the time the disease was contracted.

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[1] Ib., B. IV., 1872, p. 491.

It has been urged as a serious objection to the doctrine of dualism,

2. That in experimental inoculations with the syphilitic poison upon healthy subjects, ulcers have sometimes resulted, without a period of incubation—*soft chancres* therefore—which *were either followed by syphilis or remained as local affections.*

The experiments which are alleged in support of this statement are meagre and inconclusive. In fact, but a single experimental observation has been found which might be cited as an instance of syphilitic transmission under the form of a soft chancre, with subsequent constitutional syphilis, notwithstanding the assertion that such instances are clinically of very common occurrence. This observation, therefore, must be here related.

Danielssen[1] of Bergen, who, with the idea of thereby benefiting the Norwegian leprosy (Spedalskhed), treated a number of lepers by syphilization,

Inoculated A. J., a man thirty years of age, who had never had syphilis, with matter from a hard chancre. This man had previously, during five months, been inoculated with the pus of soft chancres without constitutional symptoms having shown themselves. From April 25th until the middle of September he had had 287 chancres, after 393 inoculations, and by the middle of September had apparently acquired immunity. On the 28th of September he was inoculated with new matter from a chancre which later became indurated. In three days a characteristic pustule developed, and with pus from this, inoculations were continued. But it was only possible to produce a few small pustules. In a short time the immunity was complete, and at the end of October all the ulcers had healed. November 15th, a scar upon the right leg, where one of the former ulcers had been, broke open again, and in the course of eight days an ulcer had developed, of oblong shape, with sharp edges and uneven, but not very deep base, which yielded a scanty, thin secretion. The region about was red, very hard, and rather tender on pressure. The inguinal glands of the corresponding side were swollen but indolent. "The ulcer healed under warm fomentations by the middle of December; the scar was somewhat hard without my noticing it particularly, since I did not apprehend any accident."

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[1] Deutsche klinik, 1858, p. 322. *Behrend's* Syphilidologie, B. III., 1861, p. 353. *Auspitz*, l. c., p. 181.

January 5th, 1858, an exanthem upon the scrotum. Beginning of February, manifest symptoms of constitutional syphilis, ulcers in the throat, etc. He was now syphilized once more, and this time with success

We are obliged here, with Auspitz, to suppose that the patient acquired syphilis through the inoculation which was made Sept. 28th, for there is not the least ground to support Boeck's assumption that it was in consequence of the first attempt at syphilization. The most difficult fact to explain, from the standpoint of dualism, is that a pustule was developed only three days after the inoculation of secretion from a hard chancre. We might assume that there was an infection with both poisons, the chancrous and syphilitic, but too little is stated regarding the source from which the inoculated matter was taken to fully justify such an assumption; neither are we justified in assuming that the lancet used was soiled with chancrous matter, though it may be presumed that the inoculation was made with the same lancet that was used in the previous case, since Danielssen believed at the time that he was taking matter from a soft chancre. But the probability is, that the affection from which he took the matter was suppurating profusely on account of its being in a state of abnormal irritation; for it has been already shown that such copious purulent discharges are capable of exciting ulceration. Moreover, the production of pustules, or inflammatory local manifestations without incubation, after the inoculation of real *syphilitic secretions upon healthy persons* is, after all, not, a very rare occurrence.

In one case of Vidal's,[1] after inoculation of the secretion of a pustule, due to constitutional syphilis, an inflammation appeared at the place inoculated on the very day of the inoculation, with suppuration and ulceration, which healed in about fourteen days, to be succeeded thirty-four days after the inoculation with a fresh development of pustules, which was followed by constitutional syphilis. In this instance purulent secretion was used in the inoculation, and the person inoculated seems, moreover, to have been especially disposed to suppurations, for the local appearances that followed, after a rather long period of incubation, also assumed the form of pustules.

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[1] *Auspitz*, l. c., p. 151.

Furthermore, there have been a number of instances where persons who had never had syphilis were inoculated with undoubtedly syphilitic secretions, and the result was the production of *merely local evidences of irritation*, varying from insignificant pustules to phagedenic ulcerations, without any symptoms of general syphilis following.

Among the experiments of the anonymous physician[1] of the Palatinate, there are three in which the inoculated places became at once inflamed; two of them healed after suppurating for from eight to ten days; in the third, pustules filled with sanious pus appeared in four places two days after the inoculation. On the following day they became confluent, and were accompanied by violent inflammation of the surrounding cellular tissue; on the sixth day a slough formed. None of the three cases were followed by constitutional symptoms.

Whether these pustules and ulcers had the character of soft chancres, with regard to further inoculability, was a point not tested. The test was applied, however, in the following case of Boeck's:[2]

A woman suffering from chronic eczema, who had never had syphilis, had been treated by B. by syphilization (*i.e.*, inoculation of soft chancres). Upon a relapse of the eczema, five years afterwards, she was to have been syphilized again. But at B.'s desire she was inoculated by Bidenkap with the secretion of a characteristic hard chancre (whether after it had been excited to profuse suppuration or not, is not stated). There resulted large pustules with quite superficial ulceration. The pus from these took in only three generations, and afterwards only produced abortive pustules. *General syphilis did not occur.*

In this case, as well as in the three previous ones, I think that we must assume that the peculiar result of the inoculations is to be ascribed to a constitutional peculiarity in the individuals, and that through the suppurative action that occurred the syphilitic virus was destroyed. Moreover, supposing that Bidenkap inoculated the secretion of a hard sore which had been artificially irritated, it is a question whether the syphilitic poison may not have been too much diluted with the pus to take effect.

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[1] Vid. Table on p. 76.

[2] *Auspitz*, l. c., p. 182.

Finally, there are a number of cases on record where, after experimental inoculations of the syphilitic poison upon healthy subjects, *the usual local symptoms appeared after a considerable period of incubation, and yet no general infection occurred.*

The first case of this sort was observed by von Rinecker.[1] A boy, twelve years of age, who was suffering from chorea, was inoculated March 17th, 1852, upon a blistered spot on the back, with pus from a primary lesion, which was covered with a scab and had likewise been produced by artificial inoculation. In twenty-seven days a portion of the sore from the blister was converted into an indolent tubercle; that became gradually covered with thin scabs, and, without treatment, was replaced in four weeks by a slightly depressed scar. *There were no constitutional symptoms.*

Among the experiments reported by the anonymous physician of the Palatinate, there are two which are here pertinent.

Case X. was that of a young woman, twenty-five years of age, who was inoculated with the secretion from moist condylomata and mucous patches in an individual suffering from secondary syphilis, September 29th, 1854. In thirty-six days tubercules of the skin had formed on the arm, which after a time began to suppurate. November 27th, they had begun to recede; there still only remained a slight desquamation. Up to the 20th of September, 1855, no general symptoms.

In Case XIII., in which a woman thirty-five years old was inoculated October 5th, 1854, with secretion from ulcers in case No. I. (see table, p. 76), ulcers formed in the places inoculated in forty-two days, and by the end of November were cicatrized. *No eruption.* With regard to other constitutional symptoms nothing is stated.

These seven cases are the only instances where, after the inoculation of healthy subjects with the syphilitic poison, any manifestations at all appeared, and general syphilis remained absent. And it is obvious from a simple comparison between them that these cases, in many respects, do not coincide with each other. The failure of the inoculation to produce general syphilis in the first series was owing to an entirely different cause from that in the second (where it is wholly obscure). In the former case we may suppose that the inflammation and suppuration which ensued rendered an infection from the syphilitic virus wholly impossible, or that the latter was immediately destroyed, together with the infected portion of tissue.

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[1] Würzburger Verhandl., B. III, p. 37.

Weighing together all the facts thus far collected, with reference to the question at issue, we cannot but regard *the chancre as a purely local, contagious affection*, and that while it may stand in some remote relation to syphilis, it does not so necessarily. Granting that the inoculable sores produced by other secretions than genuine chancre-pus, in the above detailed experiments upon syphilitic and non-syphilitic subjects, were really the same thing as the typical soft chancre, representing it, perhaps, only in a modified degree, we can only say that under certain conditions it is possible for a soft chancre to occur in a syphilitic subject in consequence of the inoculation of the syphilitic poison. But, supposing even that this Clercian chancroid were the effect of the syphilitic poison, modified by the syphilitic soil upon which it operates, ought we not, from the standpoint of the unity doctrine, to expect that, were such a sore inoculated upon a healthy person, syphilis would follow? The only observations which give us a clue to the answer are those two cases of Bidenkap, related above, where two girls inoculated themselves, out of caprice, with pus from inoculated chancres in syphilitic persons.

Although these cases lose a portion of their value from the fact that the inoculations were not performed by a physician, nor the cases observed from the start, the mere lack of uniformity in the results ought not to throw discredit upon the accuracy of the observations. For really both cases are possible, the transmission both of a permanently local sore, and of a sore which is followed by induration and general syphilis, and we have no doubt but that it was this latter event which obtained in the second case.

We hold—to be more explicit—that the chancroid of Clerc (which occurs, indeed, in the ordinary way of infection often enough), even supposing it to be produced by the true syphilitic poison, is not a syphilitic local affection, which does not manifest itself in the usual form, merely because the bearer is already saturated with the disease; and so also do we not believe that the poison remains in the insusceptible organism unchanged, to develop its usual effects upon a susceptible one which happens afterwards to be inoculated with it. We suppose, rather, that it does not develop its specific action at all upon an insusceptible (because already syphilitic) organism, but is probably quickly destroyed in the acute suppuration induced either in consequence of pus being inoculated at the same time with the poison, or else in consequence of some indefinable peculiarity in the syphilitic organism. The result of such an inoculation is, therefore, something entirely different from the *syphilitic* local affection. Although an infection with syphilis may follow the inocution of a healthy subject from such a sore, there is another reason for this than in supposing that the previously inoculated syphilitic poison has again become active. The infection in this case is due rather to the syphilitic poison which pervades the entire syphilitic organism (with all its fluids) of the individual in whom the chancroid was developed, and inoculation from the chancroid produces a syphilitic infection only when blood or its serum are inoculated with the pus; in the same manner as in the vaccination from a vaccine vesicle in a syphilitic subject where the contents of the vesicle are mingled with portions of blood that have exuded from the capillaries.

Hence in Clerc's chancroid there has been no transformation, as the unicists claim, of the syphilitic poison into some modified poison, which only produces local effects, and which may either be transmitted in this modified form to healthy persons, or, under certain circumstances, be transformed back again into real syphilitic virus; but the resulting sore, the chancre, is a thing *by itself*, and when only a simple chancre is produced by the inoculation of a healthy person with pus from a chancroid, there is no danger afterwards of transmitting syphilis in any further inoculations which may be made from this simple chancre. For there has never yet been a single instance where syphilis was caused by the inoculation of chancre-pus from an individual who had only chancre, and not syphilis.

Two inoculations of healthy persons, performed by Wallace[1], with the pus from ulcers of the genitals of a man otherwise apparently healthy at the time (Experiment VII.), and from a suppurating bubo due to pustular ulcerations (Experiment VIII.), which in both instances were followed by general syphilis, cannot be urged to the contrary of what has been said, since it was not stated whether the persons from whom the pus was taken did not become syphilitic themselves later, or were not already suffering from latent syphilis.

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[1] *Auspitz*, l. c., p. 139.

On the other hand, syphilis has followed almost invariably when the secretion of primary or secondary affections in syphilitic persons has been inoculated, whether upon such as had been formerly "syphilized" with chancre pus, or upon those perfectly healthy.

In Dr. Lindmann's case the inoculations of chancre pus had been continued for two months without symptoms of constitutional syphilis occurring during the four months following. In the case described by Danielssen (see above, p. 100) 287 chancres were developed after 393 inoculations, without syphilis being produced. But as soon as secretion from a really syphilitic source was employed for inoculation, general syphilis followed in both cases.

The number of cases in which syphilis has not developed after the inoculation of non-syphilitic persons with unquestionably syphilitic poison, is extremely small.

The objections to dualism have, as a rule, been directed mainly to secondary considerations, particularly concerning the form and general character of the sores, and with a certain justice too, inasmuch as the doctrine of dualism was founded upon the existence of a difference in the sores themselves. Instances are adduced in support of these objections, of syphilis occurring in the bearer of a soft chancre; we are confronted with cases where soft chancres were found as the source of hard sores; stress is laid upon the fact of the secretion of a profusely suppurating induration producing a soft chancre, when inoculated upon the bearer, and so it is concluded that the poison that causes syphilis, and the agent that produces only permanently local sores, are in reality one and the same. But as Bumstead shows (in the very interesting article cited above), the main point in Bassereau's distinction between the two kinds of sores lies not so much in their difference in form, as in the fact that, according as any sore from which an infection is derived, remains local, or is accompanied or followed by constitutional symptoms, so also will the sore in the individual infected remain local, or be followed by constitutional syphilis. In any given case, then, the inquiry should be: *Was there any syphilis in the infecting* *source?* To this question the confrontations of Bassereau and of many others, and indeed daily experiences give the most unmistakable answers. And the results of experiment will tend far more to sustain than controvert the inference.

Practically, the doctrine of unity can only mean that the venereal poison is capable of producing syphilis, whether the primary affection appears under the form of a soft chancre, or after a considerable period of incubation under the form of a papule, with subsequent superficial ulceration and induration; and hence, that an infection from the secretion of a soft chancre may be either followed by a soft chancre again, or by an induration and constitutional syphilis; and that, on the other hand, an infection from the secretion of an induration or other syphilitic local affection may be followed by a simple soft chancre. The doctrine of unity therefore affirms that, under whichever form the poison manifests itself, this form may become again converted into the other. There is a certain degree of truth in this, so far as the forms of the sores are concerned, but not with regard to the whole disease process. The rule is, and this is admitted, too, by believers in the unity of the poisons, "that between healthy individuals the soft chancre and constitutional syphilis are transmitted separately as such, with the same effects in the infecting party as in the party infected" (Köbner).[1] In many of the cases observed clinically which appear exceptional to this rule, is it not reasonable to question the accuracy of the observations, or to doubt the inferences drawn from the facts, when we daily witness the confirmation of facts now, which some few years ago were never mentioned even, were in fact entirely overlooked, as the incubation of syphilis for instance. Should not the apparently exceptional cases rather be made to conform to the rule? The theory of the transmission simultaneously of two species of infectious matter, each of which develops effects peculiar to itself, seems to me far less difficult of acceptation, and to accord better with observed facts than the hypothesis that the syphilis poison and the contagious principle of chancre are one and the same thing.

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[1] L. c., p. 73.

In view of the facts which we have now learned, the theory of chancre and syphilis, and their relations to one another, may be formulated as follows:

1. The *chancre* (soft chancre) is a contagious local affection which is inoculable upon the bearer, and upon others, both healthy and syphilitic, to an almost unlimited extent. It develops without incubation in twenty-four hours. Through resorption an irritation of the adjacent glands takes place, which has an acute inflammatory character, and usually leads to suppuration, *but is not followed by constitutional syphilis.* This pus has the same properties as the chancre pus.

By reason of the facility with which inoculations are effected, *several* chancres often occur in the vicinity of each other by direct communication.

Sores, more or less resembling the chancre, perhaps identical with it, and likewise inoculable in generations, may be artificially produced by the inoculation of syphilitic subjects with syphilitic, or even non-specific purulent secretions, and as it seems, too, through the inoculation of *non-specific pus upon healthy subjects.* The ulcerative action is probably due solely to the pus, though its activity may be increased by means of the peculiar constitution of the subject inoculated.

2. The syphilitic poison contained in the secretion of a syphilitic primary affection, in that of the various syphilitic local manifestions, and in the blood,

a. When inoculated upon *healthy* subjects causes at the inoculated point, *after a period of incubation* of three or four weeks, *a papule*, which becomes gradually indurated and often superficially ulcerates. After a further incubation-period there follow the general symptoms of syphilis.

In very rare and exceptional cases the local primary manifestations recede without general symptoms following.

In another class of no less exceptional cases, probably under the influence of a personal predisposition, there occurs, immediately after the inoculation, a local inflammatory process, with ulceration, as in the soft chancre, by means of which the development of the syphilitic poison is, very likely, counteracted in the part infected, and the poison may be thus destroyed. But, under certain circumstances, where, notwithstanding this, the syphilitic poison takes, *induration will follow later*, together with general syphilis.

b. When inoculated upon those *already syphilitic* the syphilitic poison either cannot be inoculated with any effect at all, or else a small abortive pustule is produced, or there results a soft sore, with all the characters of the chancre (Clerc's chancroid). This result is obtained with certainty if the secretion is taken from a syphilitic primary affection, or a constitutional local manifestation, *which has been artificially irritated into a profuse suppuration.*

3. When the induration has been developed gradually in a chancre, or where syphilis follows the latter without any induration having been perceptible, it is to be supposed, in the great majority of cases, that a double infection has taken place, on the one hand, from an intensely irritating pus—chancre poison—and on the other, from true syphilis poison. The parent sore was either double (chancre and syphilis), or it was such a sore as we have just considered (an indurated chancre), or possibly a chancre in a person already syphilitic, that is, a chancroid of Clerc.

When we remember the multiplicity of secretions which are often mingled together at the infecting source, there is no wonder that, in practice, syphilitic infection does not preserve the pure and simple character which is observed in pathological experiments.

Hence we accept only one syphilitic poison, but in another sense from that given to it in the doctrine of unity. We do not regard the contagious principle of chancre as identical with this poison. It is a pathological agent by itself, but a far less constant and uniform one than the poison of syphilis, since we have seen that it may be generated *de novo* under the co-operation of certain influences, and quite independently of syphilis.

MICROSCOPIC ANATOMY OF THE PRIMARY AFFECTION.

Robin et *Marchal de Calvi*, Acad. des Sciences, 2 Nov., 1846.—*Virchow*, Tageblatt der Naturforscherversammlung in Tübingen, 1853. (Canstatt's Jahresb., 1853,

II., S. 66).—*Buhl*, cit. by *v. Lindwurm*, Würzb. med. Zeitsch., III., 1862, S. 154. —*Auspitz*, Ueber die Zelleninfiltrationen der Lederhaut bei Lupus, Syphilis und Scrophulose. Zeitschr. d. Gesellschaft d. Aerzte in Wien, Med. Jahrbücher, XX., 2, 1864, S. 222.—*A. v. Biesiadecki*, Beitr. z. phys. u. path. Anat. d. Haut. Sitzungsber. d. kais. Academie zu Wien. Math. naturw. Cl., 1867, S. 233.—*E. Verson*, Zur Lehre der syph. Indurationen. Virchow's Archiv, B. 45, 1869, S. 117.—*A. v. Biesiadecki*, Ueber d. Verhalten der Lymphgefässe im harten Schanker. Unters. aus d. path.-anat. Institut in Krakau, 1872, S. 1. Schmidt's Jahrbücher, B. 160, 1873, No. 10, S. 60.—*M. Kaposi*, l. c. (See also the literature on p. 3.)

The microscopical examination of the syphilitic primary affection shows the tissue of the cutis and mucous membrane to be filled with great numbers of nucleated cells, which are very closely crowded together between the otherwise normally appearing connective-tissue bundles and with especial density in the adventitia of the blood-vessels. The capillaries also show numerous cells in their markedly thickened walls. According to von Biesiadecki, whose description we follow mainly, where the primary affection is distinguished by a very pronounced induration, these cellular infiltrations in the walls of the blood-vessels extend far beyond the deposit proper. The calibre of the considerably thickened blood-vessels is diminished, though the vessels still remain pervious. The mucous layer of the epidermis is not at first involved, but as the cells keep on accumulating they gradually encroach upon the mucous layer also, so that the boundary between this and the corium becomes more and more indistinct, and the epithelial layer becomes constantly thinner. In this way the regeneration of the horny layer is impaired, and molecular disintegration and ulceration take place. The disintegration may remain quite superficial or extend deeply, even encroaching upon the tissue of the cutis, in which case its connective-tissue fibres become transformed into a granular mass.

The changes in the blood-vessels explain the remarkable dryness and rigidity of the tissues in the syphilitic initial sclerosis, as well as the waxy whiteness that takes place upon slight pressure. But the peculiar, often cartilage-like, hardness of the primary affection in many cases is not fully accounted for in the above description; for, according to Auspitz, a quite similar cell infiltration obtains also in certain cutaneous diseases, as in lupus for example, where no such hardness is manifested. Auspitz regards as the chief cause of the hardness an amorphous substance, first described by him, which is interposed between the cells and the normal tissue elements. But in many cases a true new formation of connective tissue from the infiltrated cells seems to be the source of the hardness in the higher grades of the induration, as was shown by Verson, and again recently by von Biesiadecki. This new formation of connective-tissue fibres occurs particularly, according to the latter, in the peripheral portions, where, in consequence of the collateral hyperæmia, an œdema has taken place.

Von Biesiadecki found the lymphatic vessels within the morbid deposit enlarged, when, in consequence of an extension of the disease to the walls of one of the main branches of the lymphatics, the latter had suffered a contraction of its calibre or was plugged by a coagulum.

The inquiry naturally suggests itself here as to how the *minute anatomy* of the *soft chancre* is related to the above processes. Buhl found the tissues spongy, and likewise (though less densely) infiltrated with cells, and the blood-vessels were enlarged. On the contrary, von Biesiadecki did not find any such very marked differences as might have been expected. Of five cases, four showed decided infiltration of the walls of the blood-vessels, but in less degree than in the hard sore. In one instance his results agreed with those of Buhl, in that the infiltration of the walls of the blood-vessels was wanting, the vessels enlarged, and the tissue of the cutis and the cells of the mucous layer were swollen up.

Since the cells which infiltrate the tissue are doubtless derived from the blood-vessels, it is not strange that, under certain circumstances, the chancre and the syphilitic primary affection should present almost identical appearances, especially with regard to the accumulation of cells in the sheaths of the vessels. In the soft chancre, where the entire process of infiltration runs an extremely acute course, it makes a great difference at which stage the examination is made, as to whether we shall find the walls and sheaths of the blood-vessels filled with cells or free from them. But in the syphilitic initial sclerosis, which runs a decidedly chronic course, there will be a greater accumulation of cells, and when the process continues for a considerable length of time, the cells in places develop into connective tissue. The higher grades of the induration, which depend probably, as already mentioned, upon the formation of new connective tissue, only occur when the process has a considerable intensity and has been of long duration. Moreover, outward influences are doubtless not without their effect; hence, we see the induration reach its highest grade in places that are exposed to external irritations, as the orificium præputii and urethræ, the borders of the labia majora and the lower lip. But very marked indurations occur also on the posterior fold of the prepuce and in the sulcus coronæ glandis. From these cartilaginous indurations to the flat, paper-like thickenings of the mucous membrane, where the increased resistance is perceptible only in feeling of it sideways, all imaginable intermediate stages occur, *the one thing common to them all being the dense cellular infiltration of the tissue of the cutis or mucous membrane.*

Induration has therefore been often taken in too narrow a sense, only pronounced types being regarded as indurations, while sores in which only a slight degree of hardness could be felt, were held to be simple chancres. Slight thickenings of the mucous membrane belonging to the category of the parchment indurations were, therefore, not looked upon as syphilitic primary affections at all. Many apparent inconsistencies in the doctrine of the primary affection or seemingly exceptional cases are the result of such misapprehensions of the real facts. For besides the multiform character of the anatomical appearances, it must be remembered that the opinions of different observers are often at variance with regard to the signs present in any particular case. When we reflect that Ricord, with his undoubted faculty for observation, and with the immense material at his command, made every chancre, in spite of numerous inoculations, become indurated by the fifth day, we can partly appreciate how often less experienced observers may have claimed an induration where none existed, and been unable to detect one really present. But in many cases the signs do not admit of a

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positive decision. If an affection is seen to begin as a papule, at a certain time after a possible occasion for infection, and afterwards gradually enlarging, there is, to be sure, but little difficulty in determining the true nature of the case; but if, following immediately after an infection, a pustule appears, with subsequent ulceration, which is, perhaps, afterwards neglected by the patient, or irritated in various ways, as by improper treatment, it is often impossible to decide whether it is a specific induration or a mere inflammatory infiltration. Such a simple inflammatory thickening, with slight œdema, sometimes forms at a point where the preputial ring has become gangrenous in an irreducible paraphymosis, or upon a torn frenulum, simply due to an extreme derangement of the local circulation. In such cases it is often quite impossible during the first few days to say whether a syphilitic induration is not in process of development. Therefore, ulcers may occur on the genitals which show a distinct hardness, but which are not followed by syphilis, and for the simple reason that they were not produced by the syphilitic poison. Cauterizations of soft chancres, or simple applications of the nitrate of silver, are especially apt to be the occasion of such thickenings.

On the other hand, the induration may be very inconsiderable or obscure in local affections which are followed by constitutional syphilis. Particularly is this said to be the case in the female genitals; indeed, it is asserted by a large number of notable syphilographers, that an induration upon the female genitals is, in fact, a rare occurrence. From my own experience I cannot concur in this opinion. In the vast majority of cases in which a recent syphilis came early enough under my observation, the primary affection was present as a dry or ulcerating induration upon one of the labia majora, or else as a simple parchment-like thickening upon the borders of the labia minora, or in the form of several papules in process of conversion into flat condylomata. Fournier[1] very properly calls attention to the fact that the induration in females often cannot be felt, for the simple reason that in certain places, as in the introitus vaginæ, it is impossible to make the examination by touch in the proper manner. Nevertheless, I have been able in one case to demonstrate an unmistakable induration in a superficial sore in this situation. Cooper Forster is also of the opinion that indurations occur much oftener in women than has been supposed. Typical indurations may be observed in various situations in the external organs of generation, and also upon the os uteri. They occur in the form of dry or moist papules (condylomata lata) or extensive parchment-like thickenings, or of merely small and superficial erosions, in which a slight degree of hardness may be felt by pressing from the sides. It is, moreover, in females that multiple venereal affections are most apt to occur, and these may give rise to a false conclusion. Thus a soft chancre may appear upon the vulva, while a syphilitic primary affection has its seat upon the collum uteri, where it might be easily overlooked.

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[1] Leçons, p. 46.

Absence or indistinctness of the induration may be owing to the fact of ulceration ensuing and extending so rapidly as to entirely obliterate a very superficial or parchment-like syphilitic induration. Notwithstanding this, the poison may penetrate as far as the lymphatic glands and so produce its effect. Thus one might think that constitutional syphilis had succeeded to a soft chancre. According to Henry Lee,[1] the number of cases where syphilis ensues upon unquestionably soft chancres, does not exceed the number of those in which the way of access generally of the syphilitic poison into the system is not discoverable. Thus we see how the views of syphilographers differ in regard to such an apparently simple question, and we thence draw our inferences of what value is to be placed upon the alleged numerous clinical proofs of the doctrine of unity, based upon the occurrence of constitutional syphilis following a soft chancre.

When left to itself the indurated primary affection, if the induration is extensive, has a very protracted course. Months are necessary to its involution, even where a specific treatment has been pursued. In large flat indurations upon the external integument of the penis, the process of involution may be followed very closely. The elevation gradually decreases, and as the softening goes on, it becomes somewhat hollowed or umbilicated, and as it falls more and more to the level of the surrounding skin, the redness disappears and is succeeded by a brownish pigmentation, which at the periphery is uniform and pretty sharply defined, while in the centre, where slight ulceration has been, pale cicatricial lines traverse it in a reticulated form. The pigmentation disappears in the course of time, but is often to be seen for years afterwards, notably towards the edges.

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[1] Brit. Med. Journal, 1868, Vol. II. p. 568.

In large indurations upon the glans, first the cartilaginous tubercle softens, the pale, waxy hue gives place to a decided vascularization, and, even after the total disappearance of the hardness there remains for a long time a considerable degree of sponginess in the tissues, with marked distention of the blood-vessels. Pigmentation does not take place upon the mucous membrane.

The turning-point in the softening of an induration, when left to itself, is generally coincident with the outbreak of general constitutional symptoms, and the commencing involution is perhaps partly due to the influence of a febrile determination of blood to the surface, through which a more active vital process is induced in the indurated spot. In case a mercurial course has been commenced before this, its influence is quickly manifested upon the induration ; but if for any reason the treatment is suspended, the place soon recovers its former hardness again. If there was ulcertaion which had been benefited, it again begins to increase, and an already commencing cicatrix may break out afresh. Such oscillations in the course of the affection occur sometimes also where expectant treatment is continuously pursued, or even where a mercurial course has not been interrupted.

In several cases in which a mercurial course was begun as soon as the induration was well pronounced, and in which I was able to watch the course of events closely, four months elapsed before the induration wholly disappeared. In one case with very marked induration in the sulcus glandis, the induration, under the use of mercury, began rapidly to diminish in the third month of its existence, but had not entirely disappeared before seven months from the infection. Zeissl[1] never saw an induration under the action of mercury disappear entirely before ninety days, but Clerc[2] relates a case in which the induration disappeared completely in twelve days.

When an induration has entirely receded, the syphilitic primary affection is at an end, often without a vestige of it remaining; but more commonly it leaves a scar and a spot of pigmentation. But Hutchinson[3] has made the observation that the induration, after it has long been cicatrized, may relapse in the same spot. The scar becomes inflamed and hardened, and may even ulcerate without a new infection having taken place. In one case this happened in four successive years.

But these are extremely rare and exceptional cases. Where the point of infection, as in a case that Ricord relates, can be recognized after thirty years, through the presence of a distinct tubercle, it is no longer the original induration which is present, but a knot of cicatricial connective tissue. In case the ulceration has extended uncommonly deep, the loss of substance is filled up by fibrous connective tissue, and that such a place should for years afterwards be distinguished from the surrounding parts by its superior hardness is not at all strange. But there often remains from the syphilitic primary affection either no scar at all, or a very superficial and perfectly pliable one. Large cicatrices are much oftener the sign of a previous chancre than evidence of syphilis. Where there is a suspicion of antecedent syphilis, the discovery of a scar upon the genitals is therefore of but slight importance to the diagnosis, and the hope of ascertaining anything from the presence or absence of an induration in a scar that has existed for years cannot but lead to erroneous inferences.

A syphilitic primary affection, characterized by a well-pronounced induration, may sometimes be obscured through certain accidental conditions, which may stand in a more or less close relation to the syphilis, or, indeed, have nothing at all to do with it. It has been already mentioned that a laceration of the frenum, or gangrene at the preputial ring in paraphymosis, due to inflammatory and œdematous infiltration, may produce an effect simulating the syphilitic induration. This is sometimes the case in a still greater degree in fistulous ulcers, such as occur in the glands of Bartolini. Such callosities may develop about fistulous sinuses of the most various description, having no connection with syphilis whatever. Papulæ upon the genital mucous membrane, belonging to a general papular eruption on the body, may bear a very deceptive resemblance to a primary papule, especially where in certain favorable localities they ulcerate superficially or become (as is apt to occur in the female genitals) indurated. In this situation the transformation into condylomata lata is of the most common occurrence. To the conditions simulating the primary affection belong, also, cancerous new growths, particularly epithelioma, it being often necessary to resort to the microscope before making a positive diagnosis.

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[1] L. c., p. 55.

[2] Cited by *Berkeley Hill*, p. 74

[3] London Hospital Reports, Vol. III., 1866. p. 378. Compare also *Fournier*, Du pseudochancre induré des sujets syph. Arch. gen., 1868. Leçons, p. 592 s.

Sometimes in patients who have already been syphilitic for a long time, a fresh infection causes at first a soft chancre, in which gradually a certain degree of hardness is developed, so that it might be regarded as the primary affection of the existing disease, or as a fresh syphilitic infection. Henry Lee,[1] who has called attention to this occurrence more especially, thinks that in these cases the induration is due to the influence of the already existing constitutional syphilis. Finally, in the later periods of the disease gummata may develop upon the genitals, which, either with or without ulceration, may bear the greatest resemblance to a syphilitic primary affection.

ENLARGEMENT OF THE LYMPHATIC GLANDS IN THE REGION OF THE PRIMARY AFFECTION.

This is one of the most constant as well as, in a diagnostic point of view, the most valuable of all the symptoms of the syphilitic infection. Fournier[2] found it missing in only three cases out of 265 men, and three out of 223 women. The route by which the virus reaches the glands may sometimes be traced through a portion of its course by a thickening of the lymphatic vessel, which can be felt beneath the normally appearing skin as a narrow and exceedingly hard cord. Von Biesiadecki[3] found the muscular fibres in such lymphatic vessels enlarged, through the presence of numerous exudation cells; the adventitia was contracted, containing only a few of these cells; the vessel was in places plugged by a coagulum or closed by a thickening and folding of the intima. The immediate vicinity of the lymphatic vessel was but little changed; rarely a few exudation cells appeared between the fat cells. Von B. believes he has discovered the explanation of the fact that the changes in the lymphatic vessels are independent of any infiltration in their vicinity, in the presence of a few blood-vessels in the walls of the lymphatic vessel; the cells found in the walls of the lymphatics are probably derived from these blood-vessels. The course of this chronic lymphangioitis is very slow, and invariably terminates in resolution.

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[1] Holmes' Syst. of Surg., I. p. 439. Comp., too, *Fournier*, l. c.

[2] Leçons, p. 201.

[3] Schmidt's Jahrb., 1873, B. 160, S. 60.

When the primary affection is situated upon the genitals the intumescence of the lymphatic glands takes place very gradually, and is never perceptible before the primary affection; usually, not until several days after the latter has appeared. In a few cases, which I had the opportunity of observing from the start, at least from five to six days elapsed from the first appearance of the primary affection before a slight glandular enlargement could be perceived; usually of but a single gland at first. In several cases where the syphilitic poison was inoculated artificially, and attention was directed to this point, the swelling of the lymphatic glands was not observed before from the eighth to the eleventh day after the appearance of the primary papule (von Bärensprung, Hebra).

The glandular swelling attains no very great magnitude. The inguinal glands become as large as from a hazel-nut to a pigeon's egg, are not usually tender on pressure, and generally occasion the patient no annoyance, even when fully developed. For this reason they are termed "*indolent*" buboes. Only very rarely have patients who were in the habit of closely observing their bodily condition complained to me, from the commencement of the glandular swelling, of difficulty in walking.

It is not a single gland only that becomes enlarged in the inguinal region, but those adjacent also become gradually swollen, though not always in regular succession, sometimes skipping over one; this being due to the manner in which the several glands are connected with the lymphatic vessels of the genitals.[1] After a time a bundle or chain (*une pléjade*, Ricord) of such swollen lymphatic glands make their appearance, varying in size, hard to the touch, slightly movable underneath the integument, which is neither reddened nor otherwise altered. When the glands affected in the inguinal region are both numerous and very much swollen, the skin appears noticeably elevated above a smooth, somewhat nodulated tumor.

The swelling of the glands is not always symmetrical when the infectious matter has been deposited upon the genitals, nor does it always occur first upon the side corresponding to the seat of the primary affection. I have repeatedly seen a lymphatic gland upon the opposite side, contrary to expectation, become enlarged before those of the same side with the primary affection. Considering the multitudinous anastomoses of the genital lymphatic vessels, this is no more to be wondered at than that the lymphatic glands in both inguinal regions should be attacked in spite of the primary affection being situated only on one side.

This enlargement of the lymphatic glands, which is due, as may be inferred from the period at which it takes place, to a resorption from the primary affection, is, moreover, of very great value practically, since it often gives the first clue as to the point where the syphilitic poison was first deposited. While the inguinal glands of one or both sides will be attacked, if the seat of infection was upon the genitals, the submaxillary glands will be swollen if the infection occurred upon the lips. I have seen several cases where, in the presence of an induration upon the lower lip, a gland underneath the chin has become enlarged almost to the size of a pigeon's egg. Where the infection is upon one of the fingers, the corresponding cubital glands swell, or a number of the axillary glands become also swollen, or, as I remarked in one case, the glands in both these situations may become enlarged at the same time. If the nipple has been the seat of infection, a swelling takes place in certain glands on the side of the thorax below the pectoralis major, or in the deeper glands of the axilla. The older writers, as Astruc,[1] have also directed attention to these glandular swellings in the various situations of the primary affection. It occasionally happens that there has been only a slight erosion at the point of infection, or a small papule only, which became but slightly indurated or has already vanished by the time the case is examined, and then the discovery of an indolent, glandular swelling may become of the greatest assistance in finding the obscure vestiges of the primary lesion.

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[1] Compare figure in *H. Auspitz*, Die Bubonen der Leistengegend. Arch. f. Dermat. u. Syph., V., 1873, S. 453.

Histologically these glandular swellings represent *a hyperplasia of the cellular gland-elements.* According to Rindfleisch,[2] the chronic induration of the glands is due "not so much to a hardening and enlargement of the reticulum, as to a very uniform, though by no means exuberant production of young cells in all portions of the gland." The involution is effected through fatty metamorphosis and absorption. Under certain circumstances caseous and calcareous degeneration may take place.

The course is always very tedious. If left to itself the glandular swelling will continue to increase for weeks, and even under an anti-syphilitic treatment it is long before a diminution in size is perceptible. In one case that was under my observation, where there was a moderate glandular swelling in the inguinal regions, which was treated internally with mercury (bichloride) and followed a mild course, on apparent diminution in size took place before eight months from the time of the infection; the swelling persisted, therefore, for more than six months.

In individuals of a so-called scrofulous constitution, the swellings of the lymphatic glands may attain a much higher degree. Such persons are usually predisposed to considerable glandular enlargements, after even slight peripheral irritations, which often go on to suppuration, or even caseous degeneration. In such persons the syphilitic poison, too, may occasion a sufficient irritation for such marked changes.

Exceptionally, in persons with good constitutions, from an unfavorable mode of life, or through walking too much, or in consequence of other bodily exertions, the cellular tissue in the vicinity of an indolent glandular swelling may become inflamed, and the overlying skin show a considerable redness. If the patient remains quietly in bed, such an inflammation quickly recedes. Actual suppuration of a syphilitic bubo is extremely rare. Fournier observed it in but three cases out of 265 syphilitic men, and in five out of 204 women. Such a bubo suppurates, then, as any ordinary glandular abscess. No chancre sore is developed.

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[1] L. c., p. 94.

[2] L. c., p. 177.

The acute lymphadenitis, by which the soft chancre is followed, is essentially different from the glandular swelling that accompanies the syphilitic primary affection. In the former only a single gland (rarely are several swollen) becomes enlarged in the course of a few days, with great pain and other inflammatory symptoms. The inflammatory process extends rapidly to the surrounding cellular tissue, and to the skin lying above it, so that the gland beneath is no longer movable. An erysipelatous redness often extends over a considerable region. After a few days, fluctuation becomes perceptible, and a collection of pus is present. The pus from such an abscess is also inoculable, like the preceding chancre, and often exhibits this property upon the wounded skin covering it, which is converted into a true chancre sore, and this may involve the parts adjacent to a considerable extent and depth.

The syphilitic, indolent, glandular swelling does not remain confined to the gland that lies nearest the point of primary infection, but others lying in the course of the lymphatic vessels become also involved. Thus far this has been demonstrated only as far as the glandulæ iliacæ; but theoretically the glandulæ lumbales should next gradually become infected, and so the poison passing thence through the truncus lumbalis to the ductus thoracicus finally arrive in the general circulation; but we have no anatomical proof as yet with regard to the entire route. Henry Lee,[1] however, affirms, with much positiveness, that the glands of the second order, that is, such as receive their lymph from other glands, never become affected through resorption of the specific poison of the primary disease, and thence concludes that the syphilitic poison does not, as has been generally supposed since Hunter's time, infect the body by way of the lymphatic system, but through the blood circulating either in the primary affection or in the primarily affected gland. But among the reported cases of artificial inoculation of syphilitic poison, there are two where, the inoculation having been made upon the chest, not only were the first group of glands enlarged, but also those of the second and third order, an indurated lymphatic cord connecting them with each other (vid. Cases II. and III. of Bidenkap, p. 97). Moreover, Fournier[1] has reported certain observations which tend decidedly to sustain the Hunterian view.

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[1] L. c., p. 413 and 418.

In the collection of the Hôpital de Loureine there are three preparations of women who died of intercurrent diseases while affected with syphilitic sores on the vulva. In these preparations not only the inguinal glands are swollen, but there is a hyperplastic enlargement of a number of glands above Poupart's ligament. In the second case there occur in the fossa iliaca, along the blood-vessels, nine enlarged glands, arranged in three groups, one above the other, the uppermost at the origin of the art. hypogastrica. The enlargement of the glandulæ iliacæ had attained nearly the same degree as that of the gl. inguinales, among which one or two on each of the three preparations were distinguished through their greater size as the ones first attacked.

The fact that hitherto there have been so few careful anatomical investigations with reference to this point, is doubtless to be attributed to the rarity of opportunities for such examinations; there has also been a lack of microscopical examinations of the more centrally situated glands, which, while appearing intact to the naked eye, might reveal certain changes to the microscope; for we have seen how it has enabled us to follow the cellular infiltrations extending from the primary affection over large tracts of the blood-vessels. As soon as attention has once been fairly directed to this point, advantage will be oftener taken of the opportunities occasionally afforded for anatomical examinations of syphilitic subjects who die during the development of the disease, or just at the outbreak of general symptoms, in order to decide the question on strictly anatomical grounds, whether the infection of the organism takes place by way of the lymphatic system or not.

It is not to be disputed that a portion of the poison may be taken up directly by the blood-vessels circulating in the primary affection and in the indolent buboes. In behalf of the theory that the entire blood infection takes place only in this way, may be alleged the fact that the period which elapses from the first infection to the outbreak of general symptoms is of about the same length, whether the point of infection had its seat upon the upper arm or upon the genitals, in which latter situation there are several groups of glands which have first to be passed.

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[1] Leçons, p. 213.

It remains to be mentioned that Bassereau and Clerc maintain, that in certain rare cases the lymphatic glands do not show any alteration at any period of the disease. This applies probably only to extremely mild cases. Where the glandular affection is very slight, it may be exceedingly difficult to decide whether there is any enlargement or not, as in very fat persons especially, where it is often absolutely impossible.

The question as to whether a lymphatic gland may be immediately attacked without a previous primary affection upon the skin—the so-called *bubon d'emblée* of the French—has been already considered above (vid. p. 79) in speaking of infection without primary lesion.

THE SO-CALLED SECOND INCUBATION.

The period between the first appearance of the syphilitic primary affection and the eruption of general symptoms is sometimes designated as the *second incubation;* this is the period which is required by the syphilitic poison so to increase as to gradually infect the total mass of fluids throughout the body. One may imagine that not only from the first infected point, but from all the lymphatic glands, acting as depôts in which the virus accumulates, does the blood gradually become saturated with the syphilitic poison. It is not until this saturation has reached a certain degree, which differs in different cases, according to the irritability of the particular organism concerned, or of certain of its tissues, will symptoms appear at remote points or throughout the system. It is obvious, then, that the diffusion of the poison through the body takes place very slowly. Several weeks always elapse from the first appearance of the local affection before the point is reached where general symptoms break out, and this circumstance speaks also in favor of the theory that the poison advances by way of the lymphatics, and the slowness of this advance finds its explanation in the hindrance offered to the passage of the virus by the lymphatic glands.

On an average, the duration of the second period of incubation is *from six to seven weeks;* the whole time from the infection to the outbreak of general symptoms, *from nine to eleven weeks.* In a few cases that came under my observation, in which I was able to determine accurately the limits of the second incubation, it amounted to thirty-five, forty-four, and fifty-four days. In the cases of experimental inoculation (vid. table, p. 76) the shortest period noted is twelve days (Gibert's case), the longest, 139 days (case of von Rinecker); it may therefore vary, within very wide limits, between two and twenty weeks. The causes of these variations are for the most part unknown. It is commonly stated that a mercurial course begun immediately after the appearance of the primary affection may prolong this period. It is said also that the general symptoms then not only occur later, but are more isolated and present a less typical picture of the disease. On the contrary, a shortening of the second period of incubation is sometimes caused by certain unfavorable influences acting upon the system, such as deprivations, excesses (notably in the use of alcoholic drinks), great physical exertions, and mental and emotional disturbances, in short, debilitating influences of all kinds.

As the poison thus increases in the body, and gradually becomes diffused, in many patients, besides the changes at the point of infection and the enlargement of the lymphatic glands, no further derangement of the general health is apparent; they retain their normal color and do not feel ill. But in many others, especially weakly subjects, and in females particularly, a gradually increasing anæmia makes its appearance, and the patients complain of a sense of indisposition, languor, and like symptoms, and there is developed a sort of condition like chlorosis. The alteration in the constitution of the blood upon which this condition depends, stands in a close relation to the hyperplasia of the lymphatic glands, which latter deliver a larger number of white corpuscles into the circulation than usual;

but it is also connected with certain other, as yet unknown, processes in the development of the blood (vid. above, p. 33).

In many cases the commencement of general symptoms, together with the termination of the second period of incubation and the primary stage of the disease, is very sharply defined ; quite as sharply as in one of the acute exanthemata. As in small-pox or measles, so in syphilis also, may an eruption fever suddenly occur, as the precursor of, or as an introduction to further symptoms.

THE SYPHILITIC ERUPTION FEVER.

J. E. Güntz, Das syphilitische Fieber. Küchenmeister's Zeitsch., Neue Folge, II., 1863, p. 123 ; IV., 1865, p. 192. Extract from it in *J. E. Güntz*, Das syphilitische Fieber. Leipzig, 1873, p. 56 and 63. The last-named work contains an almost complete compendium of all the information concerning fever in the course of syphilis that occurs in the literature up to the year 1873.—*A. Fournier*, Leçons, etc., p. 854.

Mention is made of the eruption fever of syphilis by the oldest writers on the morbus gallicus, many of them calling especial attention to the fact of its occurring under the form of repeated rigors or of evening exacerbations of fever. But the febrile attacks that usher in the period of eruption in syphilis were not always distinguished from those which occur sometimes in the later periods of the disease. Hunter refers to this distinction, however, in remarking that, at first, the fever bears a close resemblance to a rheumatic fever, but later is more like a hectic fever. We are indebted to J. E. Güntz for more accurate investigations concerning the eruption fever. By means of the thermometer he succeeded in demonstrating the fact that the fever most frequently precedes the appearance of any manifestations upon the skin, and this has since been repeatedly confirmed by others. Hence the relation is similar to that which obtains in the acute exanthemata, where the fever also precedes the eruption of the exanthem either by one (scarlet fever) or several (measles, small-pox) days. The morbific agent is already present in the body, but different tissues and organs react towards it with different degrees of susceptibility, and the nervous system (upon which the occurrence of fever is mainly dependent) is affected earlier and with greater facility than the skin and other organs.

In the rise of the bodily temperature we have a criterion for determining with precision the period at which the general affection takes place. Güntz states that the syphilitic fever commences, most commonly, between fifty and sixty-five days from the time of infection (with a single exception it did not occur in any of his cases before the fortieth day); the period may also be deferred till the ninetieth day.

According to Güntz, the fever may consist of a sudden, marked elevation of temperature occurring but once, or it may continue for days, during which time the temperature may reach nearly 104° F., and then rapidly fall again. This recession of the fever is often only temporary, however, and merges into remittent fever of a very moderate grade, which may last for weeks. As in one case[1] that I observed thermometrically, this remittent fever may also show very marked variations in temperature, and, according to the accompanying symptoms, may present the most striking resemblance to an intermittent fever. Similar cases have been described by the earlier writers also, as Cazenave,[2] Yvaren,[3] Zambaco,[4] Lancereaux,[5] and many others.

As already remarked, the eruption fever is not an invariable occurrence. According to Güntz, it appears in about twenty per cent. of the cases; but this seems to me to be too low an estimate. According to Fournier it is commoner in women than in men.

The symptoms that accompany the eruption fever are of great variety. Apart from symptoms which pertain to every more marked elevation of temperature, such as pains in the back and limbs, general lassitude, and a feeling of dulness in the head, it is principally functional disturbances of the nervous system that occur here; and these are commoner again, and of a severer form, in women than in men. A very remarkable disturbance of this sort, to which certain writers at the time of the syphilis epidemic, Petrus Pinctor (1500), for example, also called attention, is the *craving appetite* that many syphilitic persons manifest, notwithstanding the fever present. Again, violent headache, resembling in its course an intermittent neuralgia, and characterized by nocturnal exacerbations, belongs to the commonest of these symptoms. The pains in the limbs are not infrequently confined to particular joints, and, in fact, are sometimes associated with swelling of certain articulations, so that under these circumstances the disease may simulate, very deceptively, an acute articular rheumatism. R. Volkmann[1] observes that he has once or twice seen cases which, at the period of the acute invasion of syphilis, together with an unusually marked syphilitic exanthem and violent fever, manifested the above similarity to acute articular rheumatism; and he also states that monoarticular hydarthroses, particularly of the knee, commencing acutely, and then becoming very persistent, have been observed repeatedly. Often but a single joint is affected, as, for instance, the carpo-metacarpal joint of the thumb; and it is often this affection that first brings the patient to the physician; upon a careful inspection then, a roseola is found, with other symptoms of syphilis. Treatment directed to the latter is usually followed by a rapid disappearance of the joint affection.

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[1] Ueber d. Verhalt. d. Körperwärme als Hülfsmittel z. Diagn. einiger Formen syph. Erkrankung. Deutsch. Arch. f. klin. Med., B. IX., 1872, p. 403.

[2] L. c., p. 488 and 491.

[3] *Prosper Yvaren*, Des métamorphoses de la Syphilis. Paris, 1854, p. 173.

[4] *Zambaco*, Des affect. nerveuses syphilitiques. Paris, 1862, Case 74.

[5] L. c., p. 108. See also *Güntz* and *Fournier*, l. c.

Sometimes the symptoms—the violent headache, dizziness, and fever—are of such a kind that, without careful attention, an abdominal typhus might be inferred; and in several cases I have observed an enlargement of the spleen where there had been no malaria, in the stage of the syphilitic eruption. The further course of the affection, perhaps even one day more, renders the diagnosis clear. The breaking out of the exanthem shows that it is no simple catarrhal, or rheumatic, or typhous fever, but the syphilitic eruption fever. If, as sometimes happens, the exanthem in syphilis breaks out suddenly, and in a very pronounced form, and particularly where the outbreak of the eruption occurs just at the acme of the fever, it is possible to commit the mistake of confounding the disease with measles, the eruption possibly resembling that of the latter disease, and the periods of time with reference to the occurrence of the exanthem corresponding in the two affections. Should the eruption consist of disseminated tubercles, one might easily think of varioloid, especially if a rapid recession of the fever has taken place just as the eruption made its appearance. These are by no means mere imaginary cases. It is not uncommon that the patients have not the least idea that the febrile symptoms for which they seek medical aid have anything to do with the perhaps insignificant or (as is often the case in women) unnoticed affection upon the genitals; or they may intentionally conceal the latter; or, in case the primary affection has an unusual situation, they may not even be aware that they are infected. A careful observation of the mode in which the exanthem appears, remembering that in syphilis a much longer period is required for its development, together with accurate thermometric observations of the course of the fever, will tend to render mistakes of the above description infrequent.

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[1] *Pitha* u. *Billroth*, Handb. d. allg. u. speciall. Chirurgie, B. II., 2, p. 504.

With the access of the eruption fever, or, in the absence of this, with the outbreak of an exanthem or affection of the tonsils and the parts in their vicinity, the general infection is complete, and the disease has entered upon its secondary stage, or, according to Hunter's mode of expression, the syphilis has become "*constitutional.*" The entire system is now under the influence of the syphilitic poison, and every organ and tissue may suffer in consequence.

The various forms under which all these parts may become affected will occupy us in what follows, the separate organs being considered in succession. We here take leave of the clinical course, which our discussion has hitherto pursued, and proceed to treat successively of the various series of pathological changes, as observed in each organ separately, either during the course or in consequence of syphilis, together with the symptoms thereby occasioned. This is mainly for the sake of avoiding repetitions, since otherwise a portion of the organs would have to be considered both in connection with the so-called secondary and tertiary symptoms; moreover, in regard to certain of the changes, it has not been positively determined to which series they properly belong. For the purpose of locating the symptoms with reference to the course of the disease, the above general sketch may serve as our chart.

LOCATION OF THE DISEASE IN THE DIFFERENT ORGANS.

SKIN AND MUCOUS MEMBRANE.

Albers, Ueber d. Erkenntniss u. Natur der syph. Hautkrankheiten. Bonn, 1832.—*P. L. A. Cazenave*, Traité des Syphilides. Paris, 1843.—*Bassereau*, Traité des affect. de la peau, symptomatiques de la Syphilis. Paris, 1852.—*H. Auspitz*, Ueber d. Zelleninfiltr. d. Lederhaut, etc. Wiener med. Jahrbücher, XX., 2. 1864, p. 222.—*A. v. Biesiadecki*, Beitr. z. Phys. u. Path. d. Haut. Sitzungsber. d. kais. Akad. zu Wien, 1867, S. 233.—*J. Neumann*, Ueber Syphilis der Haut. Wien. med. Presse, IX., 1868, No. 7, 9.—Id., Lehrb. d. Hautkrankheiten, 3 Aufl. Wien, 1873.—*M. Kohn* (*Kaposi*), D. Syphilis d. Schleimhaut d. Mund-, Rachen-, Nasen- und Kehlkopfshöhle. Erlangen, 1866.—Id., Die klin. u. histolog. Charaktere der Syphiliden. Wiener med. Wochensch., XX., 1870, No. 55-57.—*M. Kaposi*, Die Syphilis der Haut u. d. angrenzenden Schliemhäute, 2 Lief. Wien, 1874.—The general works on syphilis given on p. 3.

The affections of the skin, as the most apparent of the manifestations of syphilis, have always played a very important rôle in the descriptions of the disease. The earlier writers embraced them all under the name of "*pustulæ*." Still, they described the various forms under which they appear with tolerable clearness. Biett was the first who clearly delineated the characters of the different forms, with reference to elementary changes in the skin, and he adopted the term "*syphilide*," previously employed by Alibert.

The skin undergoes certain general alterations in syphilis, as in other chronic diseases, with respect to its lustre, softness, and the amount of blood it contains. We notice, particularly in the tertiary stage, or where there is a pronounced syphilitic marasmus, a sallow, harsh, and flabby skin. But besides these a great number of special forms of skin affections are caused by syphilis, and while a part of these may be produced by other causes, many of them are quite peculiar to syphilis. But even to the forms which are not peculiar to this disease, there are joined certain characters, when owing their origin to syphilis, which render them immediately recognizable as syphilitic. These peculiarities were recognized long ago; not infrequently there has been too much stress laid upon them. The most important of them are:

1. *The Color.*—A syphilitic efflorescence, after continuing for several days, or especially where it has lasted for a longer time, often assumes a peculiar red color, which Gabr. Fallopia compared to the color of ham. Swediaur chose the color of copper for comparison, and a *coppery red hue* has, ever since, been universally accepted as a characteristic mark of the syphilitic eruptions. The peculiarity of this color consists in a combination of yellow and brown, with the more or less dark red of the efflorescence. On inquiring into the source of this peculiar color, we find that it is not an exclusive mark (and therefore not a specific one) of the syphilitic eruptions. In every syphilitic efflorescence there is a circumscribed dilatation of blood-vessels, together with a certain amount of exudation of, mainly, white blood-cells into the sheaths of the vessels merely, or also into the surrounding tissue. The greater in degree the stasis, the more abundant will the exudation also of red corpuscles be, and it is the alteration of the coloring matter in these red globules which imparts to the color of the syphilides, after they have remained for some time, their yellowish or brownish shades. These shades are more distinct in proportion as the congestion of the vessels and the redness thereby occasioned recedes, and they are more pronounced, also, the longer the stasis has continued. In the same way any efflorescence, or its immediate vicinity, or scars following ulcers on the lower extremities, not due to syphilis, may also assume this color. Long-continued dilatation of capillaries and stasis of the blood is all that is necessary to produce the pigmentation. When, in addition, there is such a state of the blood as favors extravasation of its corpuscles through the vascular walls, or capillary hemorrhages such as exist in scorbuta, and occasionally in measles and small-pox, the eruptions of these diseases may present a coppery color quite as marked as in the syphilides.

The *pigmentation* left by syphilitic eruptions is the result of the conditions already stated. The pigment of the rete Malpighii becomes increased through direct transformation of the exuded coloring matter of the blood, or perhaps also in consequence of an alteration in the nutrition, due to the influence of the blood stasis. If the rete Malpighii has been destroyed by ulceration, the scar is not pigmented, and its whiteness is in striking contrast to its deeply pigmented border. The pigmentation gradually becomes paler, and, unless unusually marked, it may entirely disappear.

Pigmentation occurs also in the skin without a local hyperæmia having preceded (ephelides, chloasma, Addison's disease). Likewise there may occur, in consequence of syphilis (almost exclusively in females, according to Fournier),[1] irregularly shaped, grayish-brown pigment spots, especially upon the skin of the neck, which develop very gradually and continue for a long time in spite of anti-syphilitic treatment.

The coppery coloration does not pertain to all forms of the syphilitic eruptions in an equal degree. A certain intensity in the local process and prolonged continuance are requisite. In persons with very pale skin, and particularly in such as, at the time of the eruption, are very anæmic, it is often wholly wanting or makes its appearance only as the exanthem begins to wane, with a yellowish color. In persons with dark complexions it is often very pronounced.

2. *Polymorphous character* of the exanthem. In the syphilitic eruptions it is very common to see macules, papules, vesicles, and pustules side by side. The reason of this lies in the chronic course of the syphilides.

Notwithstanding the anatomical basis is the same for all of them, namely, a cellular infiltration proceeding from the blood-vessels, different grades of the process are sometimes attained in different situations, corresponding to which different forms are exhibited. Or the most different initial forms may finally lead to one ultimate form; thus, for instance, syphilides of the most various description may gradually all assume the form of ulcers. Where the course of the skin affection is chronic, and the separate points of efflorescence do not make their appearance at the same time, different stages of development will be present simultaneously.

Moreover, this polymorphous character is not peculiar exclusively to syphilis, but occurs, though in much less degree, in other chronic diseases of the skin (for example, in eczema and scabies).

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[1] Leçons, p. 422.

3. *The annular form* of a syphilitic efflorescence, or the grouping together of several points of efflorescence, to form either perfect circles or segments of circles similar to those observed in herpes circinatus. This form occurs rarely in simple macular eruptions, oftener in the papular, tubercular, and vesicular. A considerable length of time is necessary to its production in a single efflorescence, and it is only in such as have a long duration, as, for example, a papule or an ulcerating tubercle, that we observe this peculiar form, its development depending upon a gradual receding of the disease process in the centre, while at the periphery it continues to advance upon the surrounding sound skin. So the circle gradually extends, or its progress being irregular or interrupted, only segments of circles are produced, or several circles near each other may approach and intersect, giving rise to extremely complicated forms. A grouping of several points of efflorescence in the form of a circle also occurs, sometimes, even at the very first eruption.

Isolated eruptions, appearing after the acute period proper has passed, so-called *relapses*, are especially prone to take this form either from the very commencement or through a series of gradual changes; it is also very pronounced in syphilitic ulcerations, notably in the serpiginous ulcers.

The annular form is often very distinct, too, on the mucous membrane, especially upon the tongue, on the hard and soft palate, and on the glans penis.

4. *The absence of itching* of the skin affected with syphilides. Very often every sensation that could be occasioned by a skin eruption is so completely wanting in the syphilides that many patients are not even aware that they have any eruption. But there are also exceptions where pretty violent itching is present, especially where the exanthem comes on very acutely.

The Different Forms of the Syphilitic Affections of the Skin and Mucous Membranes.

The syphilides are still classified, with but slight modifications, according to the following division of Biett, also adopted by Cazenave:

1. Exanthematous syphilides.
2. Vesicular "
3. Pustular "
4. Papular "
5. Squamous "
6. Tubercular "

This division has reference exclusively to the external form, and since the microscopical change in the cutis and mucous membrane in all these different forms is essentially the same, namely, cellular infiltration, the differences between the separate forms are better characterized by the gross appearances than in their minute anatomy. But nevertheless some regard should also be paid to anatomical conditions in the classification, especially to the greater liability of certain components of the tissue of the cutis or mucous membrane to become attacked in some affections than in others. The very numerous forms to be distinguished may be thus better classified at the same time that the superabundant nomenclature is somewhat abridged.

Keeping the fact in view that intermediate varieties may occur, we may range the different forms in the following groups:

I. *Circumscribed Hyperæmias with but slight Infiltration.*

Macular syphilide, Roseola.

II. *Marked Infiltration of the Papillary Body:*

1. In the form of papules:

Papular syphilide.

2. In large patches:

Squamous syphilide.

On mucous membranes, or at favorable points in the cutis:

Moist papules (condylomata lata).

III. *Especial Implication of the immediate Vicinity of the Follicles* (Hair and sebaceous follicles).

1. Simple infiltration, with either scanty or no exudation in the follicles:

Lichen syphiliticus.

2. With acute suppuration in the follicle:

Acne syphilitica.

3. Exudation into small, markedly infiltrated groups of follicles, with rapid formation of crusts:

Impetigo syphilitica.

IV. *Infiltration with Subepithelial Suppuration and Superficial Ulceration.*

Pustular syphilide:
Varicella syph. Pemphigus syph.
Ecthyma syphiliticum.
Rupia syphilitica.

V. *Infiltration with Disintegration to a considerable depth (gummous development).*

Tubercular syphilide (lupus syphiliticus).

I. Circumscribed hyperæmias with but slight infiltration.

Macular Syphilide, Roseola syphilitica.

This is the earliest and most common form of the syphilitic skin affections. It is, as a rule, the first of all the various manifestations upon the integument, making its appearance not infrequently after an eruptive fever of several days' duration, and does not then become very abundant at once, but so gradually that fourteen days or more elapse before the eruption is at its height. The exanthem consists of perfectly even, rose-colored, or darker colored spots, of a size varying usually from that of a lentil to that of a pea, with a roundish or irregular shape. At first it disappears entirely under the pressure of the finger, but when it has lasted for several days, and especially if the color is rather dark, on withdrawing the pressure a yellowish discoloration remains behind, and the exanthem has already, to a certain degree, the characteristic coppery hue.

Very often at this time the infiltration of the cutis (which, according to Biesiadecki, consists in an accumulation of cells along the capillary vessels and a growth of nuclei in their walls) begins to be perceptible, on account of a certain elevation of the spots of efflorescence, which does not yield to pressure.

A syphilitic roseola may present the greatest diversity with regard to the abundance of the maculæ, as well as in their form. Sometimes it is with difficulty that a few spots can be detected upon the sides of the chest and in the groin, and again, sometimes, they are disseminated over the whole body like the eruption of measles. If certain spots are elevated, we speak of it as an *erythema papulatum.* Occasionally, along with a few small maculæ, there may be a number of large, isolated, smooth prominences, with a diameter of from one to two cm., presenting very markedly the peculiar coppery coloration, and resembling sometimes the spots of erythema nodosum.

If the eruption is only scanty, it may disappear pretty rapidly in the course of from one to two weeks; but with especial rapidity if the patient has been subjected to a mercurial course. When left to itself, it remains, as a rule, for several weeks, and, where it has already lasted for some time, there may be seen spots of efflorescence in the most various stages of development—fresh, red maculæ or papulæ, together with both pale-colored and pigmented spots. Vesicles and pustules develop very rarely during the existence of a roseola.

Eruptions that are due to other causes than syphilis may, under certain circumstances, be confounded with the syphilitic roseola. The roseola of *typhoid fever* can only give rise to such a mistake when it is exceedingly abundant, as happens in mild cases occasionally; but even then the face is always free from the eruption, which in a syphilitic roseola equally extensive would never be the case. The syphilitic roseola would scarcely appear in the form of isolated lenticular papules, developing gradually and leaving behind somewhat pigmented and slightly shining spots, as in the case of the roseola of *typhoid fever;* and furthermore, the rest of the symptoms tend to prevent a mistake.

In children a syphilitic roseola may be mistaken for *measles* or for *rubeola;* for the former particularly, if the syphilitic exanthem was preceded by a violent eruption fever. Inasmuch as *rubeola* frequently runs its course with but slight and rapidly disappearing fever, or with none at all, its resemblance to mild cases of roseola syphilitica is very great. Circumspect examination and observation of the case, with careful noting of the temperature, the absence of red spots upon the mucous membrane of the mouth and throat in the syphilitic affection; further, the absence of any catarrhal affection of the respiratory passages, such as is invariably observed in measles, the discovery of other symptoms pertaining to syphilis—the primary lesion, enlargement of the lymphatic glands, and the affection of the throat—will render it a matter of but little difficulty to establish a diagnosis of syphilis.

Certain medicaments, particularly *copaiba balsam,* may cause skin eruptions, which, though really having but slight resemblance to the roseola syphilitica, may nevertheless sometimes be confounded with it, for the reason that the affection of the genitals, for which the copaiba balsam has perhaps been used, is apt to arouse suspicion in this direction. The eruption of *erythema balsamicum* (which is much more like an urticaria or a lichen urticatus than the syphilitic roseola) consists of flat elevations and of smaller or larger papules that are often confluent, and which occur more especially upon the extensor surfaces of the extremities, on the backs of the hands, and about the joints. According to Zeissl,[1] large confluent patches are particularly apt to occur in places where the skin is continually subjected to pressure. This affection runs its course without fever, and is also distinguished by the intense itching accompanying it.

This eruption is produced under the influence of the balsamic remedies (especially of copaiba and of cubebs also), only in persons especially predisposed to it, whether these remedies have been employed in the treatment of gonorrhœa or of some other affection. Even though the peculiar characteristics of this eruption—location, form, and itching—should not be well pronounced, the diagnosis may nevertheless be made from the history of the case, that is, from the evidence of these remedies having been employed within a short time; from the discovery of the violet-like odor in the urine, or from the detection of the resin in the latter through a precipitate being produced on the addition of NO^5, and afterwards clearing up on boiling; or, in those who have taken cubebs, from the peculiar odor in the breath.

The internal use of mercury, too, appears to cause an erythematous eruption in many persons, as shown in a case of Zeissl's,[2] where, after taking different mercurial preparations, as calomel, the yellow iodide, etc., an extensive erythema was produced, chiefly on the flexor sides of the legs and arms, but also upon the trunk. I have observed a very similar eruption, unlike the eczematous eruption sometimes caused by the external use of mercurial ointment, in a patient who had been treated by inunctions. The frictions were made in the usual manner during ten days, when, one morning, a fine, papular, measly exanthem made its appearance upon the front and sides of the chest, as far down as the lower border of the ribs, in the groins, in the flexure of the left elbow, and upon the right wrist. The back and other portions of the body were entirely free. He had anointed the calf of the left leg the evening previous, the evening before that the calf of the right leg, and the third evening before, the left thigh, and the gray color of the ointment was still to be seen in the last-named situation at the time the exanthem appeared. Hence the eruption occurred in situations that either had not been touched for several days, or had never been anointed at all. The night after the eruption appeared the patient had a slight fever, and was unable to sleep on account of the itching. Two days later the eruption (it having meantime appeared slightly upon the abdomen) had become quite even with the surface, and darker colored; was somewhat ecchymotic. In eight days it disappeared. At the outbreak of the exanthem the mercurial inunctions were stopped, and a week later the bichloride was commenced internally, but similar appearances were not again observed. The connection of this eruption with the administration of the mercury cannot be very strongly insisted upon; and were it not for Zeissl's observations, where, on account of the oft-repeated occurrence of the manifestation, the connection between the two can scarcely be doubted, I should not have ventured to allude to the above case as I have.[1]

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[1] L. c., p. 110.

[2] L. c., p. 111.

The roseola syphilitica is sometimes the sole eruption that occurs during the entire course of the disease. Very rarely no eruption occurs at all, but merely certain trivial affections of the throat, especially of the tonsils. But in a disease with such a protracted course, in which slight and isolated eruptions of the skin may so easily escape the notice of both the patient and the physician, it is impossible to speak very positively upon this point. On the other hand, the roseola may recur a number of times in the course of one and the same syphilitic attack. Such relapses are commonly marked by certain peculiarities. The spots are paler, of a more grayish red, and are very few in number; the separate spots of efflorescence are larger, and exhibit more frequently the annular form, or the grouping together of several spots in a ring shape, than at the first occurrence of the eruption. With the exception of the annular variety, the relapses are usually of short duration. An erythema annulare may appear as a relapsing syphilide as late as twelve months or more after the infection.

The erythematous syphilide is not, as a rule, perceptible upon the mucous membranes (at least not as a macular eruption), with the exception of the mucous membrane of the throat. When it occurs in the throat it is in the form of a diffuse, more or less pronounced redness, sometimes accompanied by a slight œdema of the mucous membrane.

II. Well-marked circumscribed infiltrations of the papillary body of the cutis.

1. In the form of papulæ.

Papular Syphilide.

Papules, from the size of a barley-corn to that of a split pea, varying in color, according to their age, from red to brownish red, rather hard to the touch, and smooth upon their surface, or else slightly desquamating, constitute this variety of the exanthem. In this form the separate points of efflorescence are most frequently about the size of a lentil; hence the name *lenticular syphilide.* The separate papules are sharply circumscribed, at first smooth, later covered with loose epidermis, or, the latter having been rubbed off, the summit of the papule presents a dark-red and shining appearance, and soon covers itself with a thin scab through the oozing from it of a little serum. Around the base of the red summit, or the scab, is the ragged, slightly raised edge of the epidermis. Occasionally the epidermis over the papule becomes loosened (in consequence, probably, of a very slight exudation underneath it) in the form of a yellowish unbroken pellicle, which is a little thicker in the centre, and this is more apt to occur in places where the epidermis is somewhat thickened.

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[1] With regard to mercurial dermatitis, compare also *A. Kussmaul's* Untersuchungen über den constitutionellen Mercurialismus. Würzburg, 1861, p. 303 f.

The central loss, or at least a marked thinning of the epidermis, may remain for some time after the papule has receded and become perfectly level with the surface of the skin. On the palms of the hands and soles of the feet, where (on account of the thickness of the epidermis probably) the papular elevation is never very marked, there often occur, in connection with a papular syphilide over the rest of the body, certain perfectly level places, with a circular loss of epidermis, which look as though the cuticle had been punched out with some instrument. Places so deprived of their epidermis, or which may be still desquamating in the centre, represent the situation of former papules. These papules appear at first in the form of circular red spots, darker in the centre, which become gradually denuded of their epidermis within the entire area occupied by the infiltration. This affection is still often incorrectly represented as a special variety of syphilide, and is usually designated by the name *psoriasis palmaris* and *plantaris.*

Sometimes we find only round places of this sort, of from one-half to one cm. in diameter; in the furrows of the hand they are of a more oblong shape, and fissures may form, extending into the papillary body; the latter then remains exposed, or becomes covered with a scab. Sometimes a number of such spots coalesce, or they may enlarge separately. The latter is more apt to be the case where (as often happens) papules occur as relapses upon the palms and soles, the process then advancing at the periphery, either uniformly or irregularly, while it gradually heals in the centre. In this way the affection may assume a rather diffuse form, but can be distinguished from other affections resembling it—as psoriasis vulgaris, chronic eczema, or keratosis of the palm of the hand—from the fact that we find, beyond the defect in the epidermis, on the advancing edge, the flat, often coppery-colored wall of infiltration (Kaposi).[1] But where the process is decidedly chronic in its course, and the progress is very slow, the advancing zone of infiltration is not well marked, is almost quite even with the surface, and the desquamation may extend to the extreme periphery of the affected spot.

In such cases it may be very difficult to diagnosticate it from a chronic eczema. The latter, however, usually extends over the entire surface of the palm, and, while extensive patches of psoriasis palmaris syphilitica are often confined to one hand, eczema usually occurs on both hands, and is more common in corpulent or gouty individuals, or those well advanced in life. From psoriasis vulgaris, which, by the way, could scarcely occur exclusively upon the palms and soles, the chronic, palmar and plantar, papular syphilide (frequently the only manifestation of the disease) is distinguishable, inasmuch as the former extends usually from the wrist, or from the borders of the foot, and the scabs are smaller, whiter, and more thickly piled up; there is, in fact, a true hypertrophy of the epidermis, while in the psoriasis syphilitica the pieces of epidermis which are separated appear almost quite normal.

A different mode of development of the papules takes place in parts of the body where surfaces of skin lie in contact with each other. Under the influence of the warmth and moisture thereby produced, and especially where there is friction between the parts, or the irritation of various secretions, the papules develop exuberantly, become moist upon their surface, and run together in patches of large size. The papillary body (where the cellular infiltration has its principal seat) becomes hypertrophied, the epidermis becomes macerated, exudation cells are also deposited in the rete Malpighii, and thus the surface of the papules, or of the patches, which often presents a papillous appearance, falls into molecular disintegration, and is covered with a grayish, slimy secretion. So the papule comes to present that form of development which has received the names of *moist* or *mucous patch* (*plaque muqueuse*), *mucous tubercle*, *fig-wart*, or *flat condyloma.*

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[1] L. c., p. 103.

The papule appears in the form of the mucous patch on *mucous membranes* most commonly, and especially in such places as are exposed to frequent irritation, as at the mucous orifices of the body, or in the isthmus faucium. But lower grades of development of the papule are also met with upon the mucous membranes, together with all possible intermediate stages, from a very slight cloudiness and thickening of the epithelium over a somewhat reddened spot, to the thick and superficially ulcerating infiltration. While the lightest forms appear upon the genital mucous membrane as superficial erosions, there occur upon the mucous membrane of the mouth more frequently, especially as chronic and relapsing manifestations, circumscribed thickenings, with an anomalous formation and amassing of the epithelium, producing opalescent or milk-white spots (*plaques opalines*), which bear the greatest resemblance to the effect produced by a very superficial cauterization of the mucous membrane with the nitrate of silver. These spots may occur singly or in a more diffuse form, and are peculiar to the mucous membrane of the lips, cheeks, and tongue. The derangement of nutrition is often permanent, so that these places may last for years, or even never disappear. (Psoriasis membr. mucosæ, von Sigmund, Kaposi.) Upon the mucous membrane of the tongue the acute syphilitic papule usually forms circular level spots, which often enlarge at the circumference while the process recedes in the centre, so gradually assuming the annular form; and the same thing occurs sometimes upon the hard palate. On the soft palate and upon the palatine arches the entire free border may be infiltrated and superficially ulcerate, or upon the mucous membrane of the soft palate elevated thickenings of a gray or grayish-yellow color may occur.

The mucous membrane in the introitus vaginæ and on the carunculæ myrtiformes sometimes presents a swollen, cloudy, scalded-like appearance, which is very similar to that of the mucous patches, but they must not be confounded with each other. The former is observed in persons not syphilitic, in connection with a fluor albus, and is doubtless the result of a superficial maceration of the epithelium.

The minuter anatomy of the syphilitic papule has been given already in that of the primary affection (see p. 110). Indeed, it is often impossible to distinguish an isolated secondary papule by its gross appearances from a commencing primary affection. With regard to the mucous patches (condylomata lata), whose identity with the dry papules of the skin is evinced in the fact that by simply keeping them dry they change back into dry papules again, the investigations of von Biesiadecki and Lostorfer have shown that the changes in the epithelial layer are to be regarded as purely passive, caused by the hypertrophy which the papillæ of the cutis undergo in consequence of the cellular infiltration. Auspitz,[1] on the contrary, ascribes a more active part in these changes to the epidermis, asserting that as the latter becomes thickened it grows in between the papillæ, occasioning an apparent lengthening and narrowing of them, and splitting them up into arborescent forms. Lostorfer has called attention especially to the alterations in the vessels, consisting in a hypertrophy of the endothelium and thickening of the adventitia through a network of branching cells, whose meshes are filled with the round cells usually found in syphilitic affections; L. supposes that a portion of these round cells are derived from the branched cells of the vascular sheath.

The so-called *acuminate condyloma* (mucous papilloma), which has nothing at all to do with syphilis, and is caused by irritation of the skin or mucous membrane from different secretions (particularly gonorrhœal pus), and moreover is contagious,[2] must not be confounded with the flat condylomata. Its anatomical structure is essentially different, since in the one case there is a marked hypertrophy of the rete Malpighii, in consequence of a division of its cells (Lostorfer), and in the other an upward growth and branching of the papillæ, with new formation of connective tissue and dilatation of the vessels. Where extensive groups of acuminate condylomata are flattened, from being situated upon opposing surfaces, as on the labia majora, in the preputial sac, or in the folds of the anus, they may very closely resemble the flat condylomata, and, on the other hand, where in condylomata lata there has been a considerable hypertrophy of the papillæ, a more crested or cauliflower-like appearance may be assumed. In such cases the accompanying manifestations together with the history of the case, will determine the diagnosis.

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[1] Arch. f. Derm. u. Syph., II., 1870, p. 54.

[2] *Kranz*, Deutsch. Archiv f. klin. Med., II., 1867, p. 85.

The condylomata lata not infrequently become ulcerated upon the surface, the molecular disintegration not being confined to the cells of the epidermis, but encroaching upon the papillary body also, and so we have the *condylomatous ulcer.* Pressure and irritations of all kinds—from secretions present, through walking, etc.—either favor this ulcerative process or are its exciting cause. This process may even assume a specific character in the event of the condyloma having been accidentally inoculated with the poison of a chancre; indeed, through auto-inoculation chancre-like ulcers may be produced from it, as in the artificial auto-inoculations of the purulent secretion from condylomata, which have been described above (compare above, p. 92). A rapidly extending ulcer then results.

In unclean or very corpulent persons flat condylomata increase very rapidly in places where surfaces lie in contact with each other. In women the primary affection becomes often transformed, as already mentioned above, into a flat condyloma, and again a mucous patch on the female genitals, after having remained for a considerable time, may become indurated at its base, and this secondary lesion come to similate a primary affection very deceptively. This is not to be surprised at when we reflect that the primary affection is in every respect indentical with the syphilitic papule which forms the basis of the condyloma, and that secondary syphilis, generally, is nothing more than the primary affection generalized throughout the system in consequence of the blood infection. The diagnosis in these cases will depend mainly upon the chronological relations.

The *secretion* of the condylomata lata is *infectious in the highest degree.* At the point where transmission is effected in a previously healthy subject, there is developed, after the ordinary period of incubation, an indurated primary papule, or, the cir-

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cumstances being favorable, another condyloma. Great *auto-inoculability* has been attributed to the flat condylomata, and, in fact, nothing is commoner than to see a portion of skin that is in continual contact with a moist condyloma become gradually affected in the same way. There is no doubt that such a direct local infection may take place in the earliest weeks following the contraction of the disease, before the system at large has become saturated with the poison. The primary lesion is first transformed into a flat condyloma, which causes the development of a new infectious deposit upon a surface lying contiguous; for auto-inoculations from the primary affection have been also successfully made with the lancet (see above, p. 98). But much more frequently does the multiplication of condylomata (apparently due to direct contagion) depend upon an existing general disease; or, in other words, it is due to the exposure of a tissue (the papillary body), in which infected blood is already circulating, to the constant irritation of a secreting condyloma lying in contact with it; hence, the syphilis has merely come to a development in a new place.

From the foregoing description it is obvious that the condylomata lata belong to an early stage of syphilis, to the primary, or particularly to the secondary stage, and indeed are so characteristic of the latter that several writers have proposed even to designate this stage as the "*condylomatous*." Condylomata lata are exceedingly prone to relapse, and frequently they are the only form under which relapses occur at all, or, indeed, the sole manifestation of the disease within the first year after the acute period. They are not apt to appear later than this, and are never seen in connection with the gummy tumors (Zeissl.[1])

The part of the skin or mucous membrane which is more especially assailed by the syphilitic papule is the *papillary body*. Even where the papule has apparently developed in a follicle, the affection consists in an infiltration of the papillæ forming the edge of the follicle, and is not an affection of the follicle itself. Zeissl[2] makes the syphilitic papules develop mainly from the sebaceous follicles, excepting when they occur in the hollow of the hand or in the sole of the foot, and in support of this view he refers to the syphilitic miliary papule, in which, after resorption has taken place, the excretory ducts of the diseased follicle appear very distinctly as little depressions the size of pin heads, surrounded by a dark brown border. This is perfectly correct for this particular form, or so far as certain situations in the body are concerned, as in the dent of the chin and in the depressions behind the alæ nasi, where almost solely miliary papules occur; but for the most common form of the papule it is inapplicable, and for this reason we have separated the miliary form from the papular syphilide, and placed it under acne syphilitica (see below).

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[1] L. c., p. 140.

[2] L. c., p. 114.

Certain peculiarities are presented by the papular syphilide when occurring on the negro skin. The papulæ are ordinarily more strongly pigmented, the furrows of the epidermis form whitish lines, or wherever there is a loss of the epidermis the dark papules are bordered by a gray, ragged fringe of epidermis. As observed in two cases by R. W. Taylor,[1] the papule sometimes loses its pigment during the development, and becomes white ("in certain places they were snow-white with slight desquamation"). The papillæ and the deeper layers of the epidermis were found by microscopic examination infiltrated with the round cells of syphilitic growths; the pigmented layer, with the exception of a few pigmented cells, was wanting.

The papular syphilide may occur anywhere on the surface of the body, but it has certain favorite seats where it may be found even when very sparingly developed. These are, more particularly, the borders of the scalp, the forehead, where it is often arranged in the form of a continuous band (corona veneris), on the back of the neck (especially in women), and finally in all places where the skin forms folds or depressions, as on the chin, in the angles formed between the alæ nasi and the cheeks, on the borders of the axillæ, in the elbows, in the hollows of the knees, and behind the ears. In a few of the last-named situations, and in all places generally where folds of skin are in continual contact with each other (either normally or through an excessive development of the adipose layer or other pathological alterations in the form of the skin), and therefore, more especially on the external female genitals, the scrotum, beneath the dependent breasts, in the navel, about the anus, at the preputial orifice, the angles of the mouth, between the fingers and toes,[1] the papules are very apt, after a short time, to assume the form of condylomata lata.

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[1] Amer. Journ. of Syph. and Dermat., Vol. IV., No. 2, 1873, p. 107.

Upon the hairy scalp and the bearded portions of the face the papules soon become covered with crusts, which is obviously due to the external irritations to which they are subjected from being often wounded in these situations in combing or scratching.

The papular syphilide sometimes breaks out with symptoms of violent fever, but usually there is only a slight elevation of temperature, or the eruption may make its appearance very gradually without perceptible fever at all. Where a violent eruptive fever precedes the outbreak of the syphilide, the appearance of the papules might suggest small-pox. But the attending symptoms and the further course of the disease will soon reveal the true state of things.

The papular syphilide is very often accompanied by violent pains in the bones, and one of the most common affections at this time is *iritis*. After the syphilide has continued for a considerable length of time, alopecia and disease of the nails are very commonly associated with it.

The *earliest appearance* of the papular syphilide may take place at various periods in the course of the disease. Sometimes it is the very first skin affection, either because the disease has been left to itself, or because, as is usually the case under these circumstances, the patient has been subjected to an insufficient course of treatment at the commencement; in other instances it develops gradually from a roseola syphilitica, or does not appear until some weeks after this has disappeared.

The duration is much longer than that of the macular syphilide. If left to itself it may last for many months, and a mercurial course even does not cause its disappearance before several weeks have elapsed. The places on the palms of the hands and soles of the feet are especially obstinate.

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[1] *Zeis*, Deutsch. Archiv f. klin. Med., B. II., 1867, p. 271.

Relapses of the papular syphilide may occur a long time after the commencement of the disease. In the late relapses usually only isolated papules appear, and these are very apt to group themselves together in an annular form. The papulæ are especially prone to relapses upon the palms and soles; but while the eruption, as an early manifestation, or at an early stage of the syphilis, usually affects both hands or both feet alike, the later relapses are mostly confined to particular spots upon one hand or one foot, and are not apt then to present the circular form, but, as they do not spread uniformly, they become irregularly shaped, and are often more like simple fissures.

The *involution* of the syphilitic papule is first announced by its growing paler and becoming level with the surface. As the redness decreases the pigmentation becomes more evident, and if the eruption has been of long duration, dark pigment spots are left which are very slow in disappearing. The moist papules upon the mucous membranes leave no scars, unless there has been deep ulceration; upon the skin they leave either a slight pigmentation, or, on the genitals especially, or about the anus, large unpigmented spots remain, surrounded by a very narrow pigmented border. Such scars often, after many years have elapsed, are still present, the evidences of former condylomata which occupied these situations.

2. Infiltration of the papillary body in large patches.

Squamous Syphilide.

The coalescence of several papules, or the gradual enlargement of a single papule, is sometimes associated with extensive infiltrations in the cutis, and when the desquamation upon their surface is considerable, may bear a very close resemblance to the patches of a common, non-syphilitic psoriasis. Therefore, this form of syphilide may be termed, with a certain propriety, *psoriasis syphilitica.* Such infiltrations are of a dense structure, and are especially apt to develop upon the forehead, on the back of the neck, on the hairy scalp, the mons veneris, the labia majora, and upon the scrotum; but they also occur upon the extremities, flexor and extensor surfaces alike, and over other portions of the body. This eruption occurs commonly as a relapsing syphilide, appearing in isolated situations and assuming the circular or kidney form. It advances at the edges, and is covered, especially towards the borders, with loose epidermic scales, which, however, are more apt to take the form of thin yellow crusts, and are thus distinguished from the white thick desquamation of psoriasis vulgaris. Besides, the favorite situations of the latter, namely, the knees and elbows, are usually avoided in the syphilitic psoriasis.

The earliest period at which I have ever observed this form of eruption was in the fourth month from the infection. Well-marked infiltrations of the above description were situated upon the head, while upon the trunk there were only maculæ scattered here and there. In the recession which followed pretty promptly upon a mercurial course, the pigmentation was very well marked and was slow in disappearing.

Like the previous variety, this form of syphilide also becomes often transformed, in favorable situations, into flat condylomata, and is accompanied with the same affections of the mucous membrane as the papular syphilide.

III. Location of the infiltration, especially in the walls of the follicles.

The appearances of the skin eruption vary according to the grade of the cutaneous disease. But in the forms which we are now to consider, it is evident that the walls of the follicles are mainly implicated, in the fact that a hair penetrates each of the separate points of efflorescence, or at least the excretory duct of the follicle may be recognized as a minute, dark spot in its centre. Notwithstanding the similarity in their situation and in the anatomical processes by which they are produced, each of the several forms of the syphilitic skin disease coming under this head usually preserves its distinctive characters throughout; thus miliary formations run their course from beginning to end as such, and although they differ from the syphilitic acne pustules only in degree, they do not turn in to these, but either form preserves its own peculiar course.

1. Infiltration of the follicular walls, with only scanty or with no exudation in the follicles.

Lichen Syphiliticus.

The simplest form most resembles those enlargements of the follicles which occur in many persons upon the dorsal surface of the upper arm, in consequence of an accumulation and desiccation of the secretion. Hard granules, resembling dried gum, are situated beneath the epidermis, which can be excavated with the finger-nail, leaving little cicatricial depressions. But the similarity is confined to the external appearances, for in the one case it is dried secretion and an obsolete sebaceous follicle that are concerned, while in the other there is an infiltration in the follicular walls. On account of this outward resemblance this form of syphilide might be termed *milium syphiliticum.* However, it is not desirable to increase the nomenclature, and therefore the name *lichen syphiliticus*, adopted for this form by most writers, had better be retained.

Papules of this class rarely occur only singly; usually they stand ranged in groups of a dozen or more. At first they are slightly reddened, but they soon assume a shade of yellow, and may remain for a long time of the same form and size, but gradually they become flattened in consequence of the desquamation, and leave no pigment spots behind.

If the process is more acute, an exudation takes place into the follicle, and groups of little vesicles are formed, which, their contents becoming cloudy, soon turn into pustules. Moreover, the contents are so scanty that even in closely crowded groups of such vesicles the little scales or crusts that are left after their desiccation remain discrete. When these crusts fall off, small, darkly pigmented scars are left, which at first are depressed, but soon, through the increased fulness of the blood-vessels, become distinctly prominent, afterwards becoming flat again.

The further development of many of the papular groups may be varied in still another way: The papillæ of the cutis, lying between the papules, become also infiltrated, causing the entire surface of skin which was occupied by the papular group to be converted into a desquamating, psoriasis-like patch, as illustrated in the following case, which in other respects presents an example of the ordinary course of lichen syphiliticus:

H. J., an anæmic-looking man, twenty-five years of age, three months after the infection, and while the induration still remained, together with an open bubo in the left groin, had an exanthem consisting of very small papules, vesicles, and pustules ranged in groups, the contents of which dried up into little, bright-red scaly crusts. These groups occurred most abundantly upon the lower portions of the back and on the abdomen, and also upon the face, where the points of efflorescence were crowded together more than elsewhere. The upper half of the chest was noticeably free. In fourteen days, under the use of the yellow iodide of mercury, several groups upon the face and on the back of the neck had become transformed into infiltrations of a circular shape, or in the form of plaques, which assumed the appearance of a squamous syphilide. The patient now interrupted the treatment for three weeks, and when he again made his appearance a new eruption of vesicles had developed on the face and on the neck, while upon the arms there were a number of scaly red miliary papules. In a week the newly formed vesicles had turned into pustules, whose contents dried up afterwards, beginning in the centre. After the crusts had fallen off, markedly pigmented and somewhat elevated, slightly desquamating places remained, which gradually became flatter, so that then, besides the psoriasis-like places upon the neck, there were left scattered over the body spots of various sizes composed of closely aggregated brown points the size of pin-heads.

This acute form of the lichen syphiliticus is so well characterized by the grouping, and by the constitution and course of development of the papules composing the groups, that it can hardly be confounded with any other form of cutaneous disease. And the more chronic forms may also usually be distinguished without difficulty from the somewhat similar affections of the skin follicles which occur in scrofulous and cachectic individuals (lichen scrofulosorum) by taking into account the rest of the symptoms (throat affections, etc.).

The syphilitic exanthem under consideration may be variously designated, according to the different states of development under which it may appear, as a *miliary papular syphilide* (Zeissl), or, with marked exudation into the follicles, as a *herpes syph.* (Ricord), or where more extensive regions of skin are implicated, as an *eczema syph.* (Cazenave). In case the exudation into the follicles is very abundant, and where the affected points are somewhat isolated, pustules are often formed which resemble the pustules of varicella (varicella syph.) or those of simple acne.

The miliary syphilide which we have just described often makes its appearance with pretty violent febrile symptoms. It usually occurs at the commencement of the secondary period, though also, occasionally, as a relapsing exanthem, and is then rarely very extensive. There may be present, at the same time, the ordinary forms of psoriasis palmaris and plantaris, together with the affections of the mucous membranes that commonly accompany the papular syphilide.

2. Acute suppuration in the follicle.

Acne Syphilitica.

When suppuration develops in the follicle rather acutely, in connection with the infiltration, acuminate pustules upon a red or coppery-colored base are produced, which bear a close resemblance to the pustules of acne vulgaris. Therefore, this form may be termed *acne syphilitica.* Like the previous form, the acne syphilitica has its favorite seat also in the face, upon the back, and especially upon the shoulders, on the hairy scalp, particularly at the edges of the hair, on the buttocks, and upon the extensor surfaces of the thighs and legs. The pustules may develop in great numbers, in groups or quite singly, and sometimes in such small number as to be counted. When numerous acne pustules develop all at once, there may be pretty violent general symptoms, while if but a few appear at a time, these symptoms are entirely absent.

The single pustules do not become very large; they are usually about the size of pin-heads. The contents of the pustule dry up, and after the crust has fallen off a cicatricial depression is left, which remains visible for some time as a pale spot surrounded by a border of pigment, but gradually entirely disappears. Exceptionally the pustules enlarge to the size of a pea.

The distinction of acne syphilitica from acne vulgaris, in cases where only single points of efflorescence appear, just in the favorite seats of the latter. will rather depend upon other symptoms present at the same time, which point to syphilis, than upon any outward characteristics of the eruption, since under certain circumstances the eruptions in the two diseases may be exactly alike, though in the syphilitic acne the inflammatory areola is ordinarily more pronounced, and it is characterized also by a more coppery coloration.

A third form of the syphilide, with especial implication of the skin follicles, but which, on account of the formation of thicker and larger crusts, comes nearer to the following group, is peculiar from the fact that the intermediate spaces between the affected follicles do not remain intact, as in the lichen and acne, but become infiltrated at once, the same as the follicles. The hair follicles appear as vesicles lying very near each other or confluent, resting upon an infiltration varying in size from a lentil to a bean. The vesicles quickly desiccate, and greenish-yellow granular crusts are formed which cover the whole surface of the infiltration. This crust can be removed without difficulty, and beneath it is found a loss of substance with an uneven surface. This form is called

Impetigo Syphilitica.

Very similar crusts and ulcers may be produced in syphilitic eruptions which follow another course of development, the pustular formation not proceeding so directly from the follicles ; these eruptions belong to the next following group. But in these the eruption usually develops in isolated spots, while the form just described occurs more like an acute exanthem, with tolerably copious eruption, and pretty early after the infection, frequently as early as in the third or fourth month.

The outbreak of the eruption is sometimes accompanied by violent fever, which may have a markedly remittent character and be ushered in with chills and sweating. In addition to this, periosteal swellings may be present at the same time, with violent pains, and notably with pains in the head, which, on account of their occurring regularly every evening, often resemble a typical malarial neuralgia. This form of eruption is most apt to occur in persons of poor constitution, or in individuals whose health has been broken down through previous diseases.

The favorite seats of impetigo syphiltica are the face, the hairy scalp, in the beard, and in other regions where thick hair grows, as in the middle of the breast. The extremities usually remain free, or only isolated spots occur upon them. The affection could scarcely be mistaken for a non-syphilitic impetigo, since in the latter the crusts do not rest upon infiltrations. Moreover, the attending symptoms, particularly the primary affection, which is usually still present, will tend to facilitate the diagnosis.

The loss of substance caused by impetigo syphilitica heals either with the production of a scar, which is at first uneven and pigmented in places, and afterwards becomes smooth, thin, and white, like the pit from a small-pox pustule, or else it continues for some time to enlarge on all sides, or only in one direction, the ulcerative process advancing at the edges, leaving irregular and disfiguring cicatrices.

IV. Infiltration with subepithelial suppuration and superficial ulceration.

Pustular Syphilide.

In the eruptions of this group the pus is not situated in the cutaneous follicle, but underneath the epidermis, independently of the follicle. The pustules develop rapidly, are rather small in size, and may look very much like those of the previous group, and we may have the production again of eruptions, resembling varicella, herpes, or acne. But the points of predilection for the pustules of this group differ from those of acne syphilitica and of the form of impetigo just described, being situated chiefly in places where the skin is *tender*, namely, beside the face, the flexor surfaces of the extremities and the sides of the trunk, and, indeed, in places where there are no follicles at all, as the palm of the hand. Moreover, these pustules are much more superficially situated than those which proceed from the follicles, and consequently leave only very shallow depressions, even immediately after the crusts have fallen off.

Zeissl[1] calls the large-sized pustules (which by others, especially the French writers, are designated as *pemphigus syphil.*) *varicella confluens*, and he reports two rare cases, one from his own practice, and the other from the Hôp. St. Louis, in which the palms and fingers of both hands were covered with pustules as large as split peas. In his case they appeared like poorly developed variola pustules without the areola. At the tips of the elbows the pustules developed upon places which were at first of a dark red color, with some thickening.

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[1] L. c., p. 147.

If, not contented with the simple "*pustular syphilide*," we are to preserve any special name for this form, I should prefer the term *pemphigus syphiliticus* to *varicella*, since the disease has a greater resemblance to the pemphigus of non-syphilitic persons, and moreover, the very similar form in new-born children with hereditary syphilis is commonly known as *pemphigus syph.* (neonatorum).

Ecthyma Syphiliticum.

The ecthyma pustule is the typical form of the pustular group. It may be described as an elevation of the epidermis by a cloudy fluid, which soon becomes purulent, and not infrequently is tinged with blood, over a reddened base. Ecthyma usually appears in isolated spots, the pustules being separated by wide interspaces, in contrast with the pemphigus syph. neonatorum, and with the form in adults just mentioned, as well as with the ordinary form of varicella syphilitica; these all occurring more as an acute exanthem. Though it may occur in any part of the body, its favorite seat is the legs below the knees. The pustules develop very quickly, following a hyperæmia of the affected spots that has existed for a short time previously. In other cases this prodromal stage lasts for a longer period, and the pustule does not make its appearance until the skin at this point has become more or less infiltrated.

The same diversity may be presented by the affection in its further course, inasmuch as we find after desiccation of the pustules quite superficial excoriations beneath the scabs, or in other cases deep ulcers may be developed, which extend at the edges and occasionally assume a serpiginous form. Hence many writers describe an ecthyma *superficiale* and *profundum.*

The lesser forms of ecthyma may present a very marked similarity to the above described impetigo syphilitica after the scabs have formed. But the crust of ecthyma is generally darker colored, especially if the contents of the pustule were bloody; the crust, too, lies deeper in the cutis than in impetigo, where, on the contrary, it is somewhat raised above the level of the skin, on account of the infiltration beneath it; finally, the ulcer underneath the scab in ecthyma has a sharply cut edge, in impetigo the edges are elevated and like a wall, and while in the former the bed of the ulcer is composed of disintegrated tissue, in the latter it often presents the aspect of an irregularly granulating surface.

The scars of ecthyma are generally round, and remain pretty red for a considerable time; later they are either (depending upon the depth to which the destructive action has extended) slightly pigmented or perfectly white; they are somewhat depressed, and surrounded by a border of pigment.

Ecthyma is a manifestation more especially of the *later periods* of syphilis, as evinced in the unsymmetrical and dispersed manner of its occurrence. Furthermore, it is an evidence of a poor constitution, and one generally disposed to suppuration, and this disposition may show itself in similar ecthyma pustules which are not due to syphilis (e. cachecticum). In such as are thus predisposed to it, ecthyma may make its appearance quite early in the course of syphilis, even within the first half year. Bad hospital influences, which give rise to scurvy and hospital gangrene, may also have something to do with the development of the severer forms of ecthyma profundum.

The affections of the *mucous membranes,* which are present at this time, likewise show a proneness to suppurative disintegration; small aphthous-like sores appear in the mouth, deep ulcers of the tonsils, or destructive ulcerations upon the soft palate. Moreover, suppurative processes in the bones often accompany this form, together with febrile symptoms of a pronounced remittent type, which may continue for weeks. In such cases it is often difficult to decide whether the disease is in its secondary or tertiary stage. Gummata of the skin or subcutaneous cellular tissue may also be present at the same time with the ecthyma.

Pustular exanthems with very large pustules were formerly termed *bullous* syphilide. Such large pustules commonly give rise to that form of the syphilitic cutaneous affection which bears the name of

Rupia

(from ῥυπος, filth). By it we understand large, dirty, brownish-green, stratified crusts in the shape of a cone, resting upon a perfectly flat, ulcerated surface. The conical shape is produced in the following way: At first only a small scab forms, perhaps the size of a gold dollar, but the ulcerative process beneath advances slowly beyond its edge, and so each successive layer of the scab gives a little broader base to the crust, at the same time that it gradually increases its height. If the ulceration advances uniformly at all parts of the periphery, the summit of the cone will always remain in the centre; but if it advances irregularly, or only in one direction, the top of the scab gradually assumes an eccentric position, and this latter is the more usual case. These crusts are very much like oyster shells.

The purulent bulla, out of which the summit of the rupial crust is formed, develops from an infiltration of the cutis, which takes place very rapidly, and while the crust increases in size this infiltration slowly advances at the periphery. The epidermis around the edges of the crust is elevated by the pus to a slight distance beyond the scab, and as this ring of pus dries, the crust enlarges in circumference. It may attain the size of a half-dollar, but is rarely larger. When the crust is removed, a livid-red ulcerated surface appears, which in very large rupia spots is usually somewhat filled out in the centre, and a moist dressing being applied, this part is soon covered with epidermis. Towards the circumference the ulcer grows gradually deeper, and has sharp-cut edges. Thick crusts, resembling rupia, sometimes form from other syphilitic ulcerations, which follow a different course of development from that of rupia, as from impetigo, ecthyma, or from a disintegrating tubercular syphilide.

The *process of cicatrization* does not always go on with perfect regularity, but the ulcer may cicatrize earlier in one place than in another, and after a time the previously circular spot, covered by a conical crust, becomes converted into a kidney or horseshoe-shaped ulcer that cicatrizes on its concave side while it slowly advances on the convex, and is covered with a narrow scab, which at the convex border is bevelled to a thin edge. Such ulcers, proceeding originally from rupia, may continue to extend for years, and convert extensive tracts of skin into cicatricial tissue; they may also, however, develop from other pustular syphilides, and owe their origin to a disintegrating tubercular eruption far oftener than to rupia.

The *cicatrices*, whether due to simple, roundish, rupial spots, or to serpiginous ulcers, are permanent. They become gradually very white, are usually quite smooth, sometimes are traversed by small blood-vessels, and are surrounded at first by a pigment border that in time disappears.

Rupia was formerly classed with the syphilitic manifestations of the tertiary group. It breaks out sometimes, however, within the first six months after infection, in a tolerably acute form, and, indeed, not only, though in by far the greater number of cases, in persons of very poor constitution; but it is often a manifestation of the later periods, and is associated with marked syphilitic marasmus, gummy tumors, and necrosis in the mucous membranes and bones. Fever does not often attend the rupia of the later stages of syphilis, though a violent remittent fever accompanies its acute and premature occurrence, the same as other syphilides which tend to ulceration.

Rupia is generally *unsymmetrical* upon the extremities, as well as upon the back, breast, and head. It may not be exclusively rupial spots which are present, but other suppurative forms of syphilitic skin eruption, as acne and ecthyma, may exist at the same time. In the event of an improvement in the constitution, the rupia may heal spontaneously. But it always lasts for a good many months.

V. Deep infiltration and disintegration. (*Gummous formation.*)

Tubercular Syphilide.

The gummy tumor (see above, p. 35) may develop in the skin in the form of roundish tubercles, or of tolerably large tubercular groups, which present the often-mentioned crescentic or circular arrangement. At a certain stage of their development these groups may appear precisely like those of the papular syphilide; still, their manner of development is different, their color usually darker, and in their course they differ very decidedly. The syphilitic cutaneous tubercle begins its development usually in the deeper layers of the cutis, and not in the papillary body. Therefore at the commencement, only a papule can be felt in the skin, and there is no redness present. The latter only appears as the tubercle approaches the surface and begins to cause some elevation; then, the redness increasing in extent and intensity, we can almost mark the gradual ascent of the tubercle through the integument. Gradually the papillary body becomes involved in the advancing process, and the epidermis above participates now in different ways, either in the form of desquamation merely, or a scanty serous exudation takes place, which, drying, forms together with the epidermis a small crust, resting upon the summit of the tubercle.

In contrast with these tubercles, which tend to resorption without ulcerating, and occur, usually, in the form of isolated, semicircular groups, especially upon the shoulders, on the face, and on the extremities, there is another form, in which disintegration and ulceration ensue very rapidly. These latter processes take place through the epidermis being raised above the tubercle in the form of a pustule which quickly desiccates, the ulceration extending underneath the crust; and such a place may occasionally resemble a rupial spot, or it assumes at once the form of a serpiginous ulcer. Or the process of softening may be similar to the development of a furuncle, as is more apt to be the case in the larger isolated tubercles which grow up from the subcutaneous cellular tissue. Such a tubercle looks then like a furuncle, about the size of a pea or hazel-nut; it becomes gradually of a bluish red color, and, when it breaks, a grayish yellow, gummy-like matter is discharged, not a kernel of connective tissue, as in the true furuncle. An ulcerating cavity remains behind, which either little by little is filled by granulation and cicatrizes, or it continues to enlarge, becoming a flat, encrusted ulcer with swollen edges, which commonly, through healing in one part and advancing in another, assumes a *serpiginous* character.

The scars left by the *dry* tubercles of the tubercular syphilide, after resorption has taken place, even when the epidermis over the tubercles has remained intact, or has merely suffered a slight desquamation, are somewhat depressed, and—since the rete Malpighii is involved in the disturbance of nutrition—devoid of pigment, although occasionally in certain spots and at the edges especially, the pigmentation may be very marked. The *softening* and *disintegrating* tubercles invariably lead to the production of connective-tissue cicatrices, which are, at first, of a livid hue, but gradually become paler, and are surrounded by a brownish border. After a few years they form a striking contrast with the sound skin around them, on account of their whiteness, smoothness, and dryness. Unlike other scars, they undergo but little contraction, so that even large cicatrices of this sort lead to no deformities from mechanical distortions, except in case of extensive destruction of the subcutaneous cellular tissue.

Sometimes the process of ulceration and cicatrization in the tubercular syphilide is very irregular. A group of closely aggregated tubercles becomes disintegrated in spots, giving the whole a riddled appearance ; then bridges form, as in scrofulous ulcers, of infiltrated or cicatricial tissue, with little follicle-like cavities between, which are filled with pus, beneath which the destructive action continues. I have often observed such forms upon the backs or borders of the feet. They often prove very intractable. The cicatrices that are left are also irregular, uneven, traversed by thick bands, and show a marked proneness to break down in ulceration again.

The above forms of the syphilitic tubercles, as well as the dry tubercular patches, present a marked similarity to different forms of *lupus ;* whence the name *lupus syphiliticus*, with the various qualifying phrases (exulcerans, serpiginosus, etc.) with which these forms have been designated.

This resemblance may render the diagnosis a matter of some difficulty. A single small tubercle, or a group of dry tubercles extending peripherally, or even ulcerating tubercles of *lupus vulgaris* may, at first sight, have the exact appearance of a *tubercular syphilide.* If the history of the case affords no ground for a diagnosis, or if the earlier periods of a syphilitic attack have left no traces behind, or where there are no collateral manifestations pointing to syphilis, it remains only to decide the case ex juvantibus. The various forms of the tubercular syphilide undergo from the use of the iodide of potassium a marked change for the better, while the same treatment in lupus vulgaris is without effect. This was well illustrated in a case of mine, where a lupus vulgaris of the cheek, in a young girl, on account of its eccentric spreading, and the brownish color of its tubercular edge, offered the greatest similarity to a lupus syphiliticus. Sometimes we can ascertain something from the course pursued by the affection; this is much more protracted in the lupus vulgaris than in the tubercular syphilide. The markedly ulcerative forms of lupus vulgaris of the face are more apt, as Zeissl[1] has shown, to be accompanied by decided evidences of reaction, by extensive redness, or even œdema of the surrounding parts, while the margin of infiltration in an ulcerating syphilitic tubercle is generally sharply defined against the adjacent healthy-looking skin.

Ulcerating tubercular syphilides are distinguished from *scrofulous ulcerations* through the absence in the former of reactionary manifestations in their vicinity, but especially through their different behavior under treatment with the iodide of potassium. Moreover, the scars from scrofulous ulcers differ materially from those of a tubercular syphilide in their elevation and livid color.

Cancer of the skin, under certain circumstances, may simulate a tubercular syphilide, especially on account of the cachetic appearance presented by the patients in both affections. The very rare *multiple, cutaneous cancer*, whose tubercles have a certain resemblance to the slowly growing syphilitic tubercles of the skin, is, perhaps, less liable to give occasion to an error in diagnosis than *epithelioma*, which might readily be mistaken for an ulcerating tubercular syphilide, when situated upon the nose, lips, or genitals. But the associated manifestations, the frequently marked enlargement of the lymphatic glands in the vicinity of an epithelioma. together with the facts elicited from the history of the case (which should always, in such doubtful cases, be ascertained with especial care), the microscopic examination, and, finally, the therapeutic test (also of great importance in doubtful cases) with the iodide of potassium will tend to prevent any such errors in diagnosis.

It is chiefly upon the *nose* that other conditions are met with which may simulate a tubercular syphilide. To such conditions belong certain very inveterate forms of *acne rosacea* with marked hypertrophy. On close examination, however, the more livid than brownish-red colored acne tubercles, commonly traversed by varicose blood-vessels, may be readily distinguished from the smooth, coppery, sharply defined tubercles of syphilis.

The formation of syphilitic tubercles in the *mucous membrane* is associated with a more decided hyperæmia of the surrounding parts than in the cutis. It is very seldom that an opportunity is afforded to observe a tubercle of the mucous membrane, of the soft palate, or of the posterior wall of the pharynx, for example, before it has reached the surface. A marked prominence is then noticed, with an intense redness, which gradually shades off into the hue of the surrounding membrane. Usually the affection is not seen before ulceration has taken place. The ulcer has sharply cut edges, a yellowish, purulent base, and the parts about are swollen and intensely red. Such ulcers in the throat often become very extensive, particularly upon the posterior pharyngeal wall. They occur also in the large intestine, especially in the lower part of the rectum, and, through their cicatrization there, occasion considerable stenosis, which is also the case when they occur in the mucous membrane of other passages, as the trachea, for instance. Sometimes upon the genitals such ulcerations proceeding from tubercles of the mucous membrane are so very like phagedenic ulcers or chancres, that only the most careful scrutiny of everything relating to the case will prevent mistakes.

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[1] L. c., p. 174.

The tubercular syphilide belongs to *the tertiary group* of the syphilitic manifestations; amongst the *concomitant symptoms* gummous processes may be present in the subcutaneous cellular tissue, in the periosteum, or in the bones, in the testicles and internal organs; upon the skin isolated pustular eruptions may be associated with it, especially rupia. *Condylomata lata do not appear as late as this*, and this fact may be made available in determining the true relations of extraordinarily developed papules in a papular syphilide which may look like a tubercular syphilide.

The *course* of the tubercular syphilide is very protracted, and in cases even that are very amenable to treatment, this form is exceedingly prone to relapse. *Fever* is not present usually in this form, unless some other associated process, such as bone affections, should give rise to it. Even very extensive serpiginous ulcerations run their course without febrile symptoms.

The patients suffering from a tubercular syphilide are generally more or less cachectic; amyloid degeneration of the abdominal organs often coexists. Usually, a number of years have elapsed since the acute stage of the disease. Zeissl, however, saw a case in which an ulcerating tubercular syphilide occurred in four months after the infection. The earliest period at which I have observed it, was at eighteen months from the contraction of the disease, in a man twenty-two years of age, in whom, besides disease of both testicles, slight icterus, tenderness of the cervical vertebræ and fever, a pustular eruption appeared upon the skin, and in the subcutaneous cellular tissue there were developed a number of roundish tubercles, extending to a greater or less extent through the whole thickness of the skin—so that over some of them the skin was already reddened, while over others it appeared unchanged. A two months' treatment with the iodide of mercury caused all manifestations to disappear.

THE HAIR AND NAILS.

These appendages of the skin likewise exhibit changes, not infrequently, in consequence of syphilis. A relatively common occurrence is *loss of the* HAIR—*alopecia.* In an extreme degree of the affection it may implicate every hair in the body. Even the old writers used to make merry over the ridiculous appearance presented by such hairless individuals, and they remark that this symptom, which at the time of the syphilis epidemic was not known, first made its appearance towards the end of the sixteenth century. (A. Musa Brassavolus, 1553.)[1]

It is obvious that the hairs will be destroyed when the deeper forms of syphilitic skin disease, the ulcerating forms particularly, affect or perhaps destroy the cutis in its entire thickness. Upon scars produced in this way the hair never grows again, leaving bald spots of greater or less extent upon the scalp, in the beard, or the eyebrows.

The alopecia which was mentioned above, however, occurs without any visible change in the skin having taken place. The hair merely loses its lustre, becomes dry and often discolored, and upon combing it the hairs easily fall out. Upon the head this may occur to a pretty large extent, though at first there is only a thinning of the hair in certain spots. Even in nearly total baldness (which, by the way, is a very rare occurrence) the scalp has almost a perfectly normal appearance; the follicles may be even more distinct than usual. The skin is not smooth and shining, as in the common calvities.

This variety of syphilitic alopecia is very much like that which occurs in consequence of certain acute diseases, and is one of the *early* manifestations of general syphilis. It begins usually at the time when the languor, headache, pallor, etc., announce the approaching outbreak of an eruption fever or a skin affection, and lasts for a number of months; but young persons, as a rule, regain their former luxuriance of hair. In the advanced secondary period, too, the alopecia may still occur in connection with relapses upon the integument, scarcely later, however, than in the second year after infection. Finally, it may occur as a concomitant symptom in the syphilitic marasmus. The local condition to which it is immediately due is, doubtless, a derangement of nutrition in the hair papilla, perhaps a scanty cellular infiltration of the papilla. It is not always especially anæmic individuals in whom the highest grades of alopecia are observed.

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[1] Aphrod., I. p. 659.

There is a prevalent opinion, which has been handed down from remote times, that the use of mercury favors or actually causes falling of the hair. This assumption is without foundation, the fact being that under a judicious mercurial course we see the growth of hair in syphilitic subjects rapidly improve.

The NAILS show alterations in their texture, either independently of any obvious affection of the matrix, or else in consequence of such affection. Accordingly, the first form of the syphilitic affection of the nails corresponds to that form of alopecia which we have just described ; the second, to the obliteration of the hair through the grosser morbid processes in and about the hair follicles.

When the nail by itself is diseased it presents either merely a lustreless surface, or numerous white spots appear, such as are very commonly seen in young persons in normal health ; or a number of parallel rows of little furrows are observed, at first separated by rather wide interspaces, afterwards approaching gradually closer to each other. In this way the nail becomes thinned at its posterior extremity at first, so that here it can be easily dented. As this thinned spot extends forward, the entire nail becomes gradually thinner and wavy. This condition, which is termed *onyxis* or *onychia sicca*, is uncommon. According to Fournier's statements it must occur much more frequently in

France[1] than in England. In one case of it that I saw, there was marked alopecia of the hair of the head, beard, eyebrows, and cilia; but in another case the hair showed no alteration and the secondary symptoms were almost entirely limited to a very obstinate affection of the mucous membrane. In this case the affection of the nails occurred in the eighth month after infection, did not implicate all of the nails, and in eight months more it had disappeared. The onychia occurs under other forms also; for instance, a great frangibility of the nails may be produced, especially of the finger-nails, so that they are constantly splitting off at the ends (the so-called psoriasis of the nails), and this is met with most frequently in women. The development of the nails, however, may not only be more or less interfered with in its superficial layers, but their growth may cease entirely, and, in this case, the nail gradually advances forward with a posterior free, jagged edge, and thus at length becomes wholly disengaged from its bed. As stated by Fournier,[2] a toe nail may be lost in this way without the patient's knowledge. A new nail is gradually produced, which may either be normal in its appearance, or present various degrees of deformity.

The coarser processes which take place in the matrix, and which, according to their situation, may or may not be accompanied by alterations in the nail, are designated by the term *paronychia.* Most frequently an efflorescence of a papular syphilide, developing on the fold of the nail, or alongside of it, is the source of the paronychia in its lighter forms. On the nail wall [the skin projecting over the root] it generally merely leads to a slight desquamation and to some alteration of the nail, while papules at the lateral edges are sometimes converted into condylomata lata, which crowd the nail, laterally, from its bed. Such moist papules of the matrix are more commonly observed upon the toes than the fingers, and may resemble closely an ulcer from an ingrowing toe-nail; they often owe their origin, indeed, partly to the same cause, namely, pressure. Severer forms are produced by pustular or tubercular syphilides upon the fold of the nail. Suppuration or ulceration then takes place, which interrupts the nail-growth, or the fold of the nail may be entirely destroyed. In the latter case no new nail grows, but merely irregular islands of horny substance are developed upon the matrix. Such ulcerative processes are accompanied by considerable swelling and great pain usually, on the big toes especially.

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[1] Compare also *R. Bergh*, Behrend's Syphilidol., III. p. 426.

[2] L. c., p. 469.

Finally, both matrix and nail may be implicated in the formation of a gummy tumor proceeding from the cellular tissue or periosteum of the same member.

SUBCUTANEOUS AND SUBMUCOUS CELLULAR TISSUE, FASCIÆ.

In considering the tubercular syphilide it was observed that gummy tumors, which gradually extend through the skin or mucous membrane, originate in the subcutaneous or submucous cellular tissue. They occur underneath the skin as flat, roundish, and (when not proceeding from the fasciæ) movable and perfectly painless tumors, which are often discovered only by accident by the patient or physician. Gradually adhesion of the integument takes place, then the latter becomes red and painful, and the tumor softening, the skin breaks, as in a cold abscess or a furuncle, from which deep ulcers proceed of the character already described. These tumors may vary in size from a pea to a goose's egg. Sometimes several of them in the subcutaneous cellular tissue coalesce, so that the infiltration has more of a diffuse character.

The minute anatomy of these growths has been already given (see p. 35). According to its stage of development the tumor on section has a grayish-red, in certain places a more grayish-yellow, exsanguinated appearance, and is either softened in the centre to a gummy-like mass, or is partly or entirely dry, resembling colorless fibrine, as illustrated in a very notable case described by W. Adams.[1]

In a lady, thirty-one years of age, there were developed within nine years, at different times, upon the right leg—and with a single exception only in this situation

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[1] Transact. of the Pathol. Soc. of London, Vol. XX., 1869, p. 309. Compare also a case of *Dittrich*. Prager Vierteljahrschrift, 1850, 2, p. 49.

—more than one hundred tumors, which at first continued to increase for from three to six, or even to twelve, months without pain, then became inflamed, swollen, and ulcerated, and when left to themselves gradually disintegrated with the production of an excessively fœtid discharge. The exposed tumors had a yellow color, and the consistency of a cow's udder. They were not vascular, and consisted of an indistinctly fibrillated, partly finely granulated basement tissue, in which, besides fibres of connective tissue, with numerous nuclei, there were imbedded a large number of fat-cells. This unusual constitution appeared to A. Bruce, who examined the tumors microscopically, to be owing to the fact that the tumors proceeded from the adipose tissue.

The patient, whose husband had been syphilitic, but who herself, so far as could be ascertained, had never during twelve years of sterile married life presented symptoms of the earlier stages of syphilis, had been suffering during the last three years from affections of the periosteum and joints, besides a deep ulcer in one tonsil. The above-described affection was not at first regarded as syphilitic, and therefore the patient was not placed under specific treatment. Later, mercury in any form always had a good effect, and especially upon the bony and articular affections. The iodide of potassium invariably induced a great depression in the patient, and for this reason could not be used. Nevertheless, at the end, under the use of the iodide of ammonium for about three months, the tumors disappeared, and did not return.

If gummata of the subcutaneous cellular tissue, or of the fasciæ occur singly, without other manifestations or evidences of syphilis, their diagnosis may be doubtful; and when they soften and the skin above them is thinned, they may be taken for simple cold abscesses. I have seen such a tumor, distinctly fluctuating, proceed from the tendinous expansion of the occipito-frontalis muscle upon the forehead of a young person. It developed without pain, and disappeared in a very short time entirely, under the experimental use of the iodide of potassium. A careful inspection of the patient, which was made at the time, revealed the presence of an old node on the right tibia.

A large number of still hard subcutaneous gummata may be mistaken for multiple subcutaneous cancers or fibromata; and in the absence of any circumstances in the history of the case, or of associated manifestations which might throw light upon the diagnosis, the decision will have to depend upon the course which the disease pursues, or upon the result of an anti-syphilitic treatment.

In infants with hereditary syphilis, the by no means rare subcutaneous gummata described by von Rinecker as syphilis nodosa, and anatomically examined by Virchow[1] and Förster,[2] are precisely like the furuncles of atrophic children, but their contents, however, do not consist of pus or a kernel of cellular tissue, but of a muco-purulent fluid which contains chiefly granular detritus. Other signs of syphilis, such as these children invariably present, the gradual development of the tumors from the subcutaneous cellular tissue, and the character of their contents—will insure the correct diagnosis.

Gummata developing in the subcutaneous cellular tissue cause extensive ulceration of the mucous membrane, particularly when they occur in the throat.

BONES.

Virchow, Archiv, B. XV. p. 237 s. Die krankh. Geschwülste, B. II. p. 398 s.—*R. Volkmann*, Pitha und Billroth's Handbuch d. Chirurgie, B. II., 2, p. 262 s. In these works the literature of the subject is given in full.

In the first description of syphilis by Marcellus Cumanus (1495), mention is made of the pains in the limbs, and in various writers of the fifteenth and sixteenth centuries we find minute accounts of the anatomical changes to which the pains in the bones are due (see citation from Fallopia, p. 35, where reference is made to gummata of the bones).

Pains in the bones begin to occur as early as at the period of the eruption fever, causing the patients sleepless nights. On account of their frequently widespread, sometimes wandering character, and their tendency to occur only in the regions of the joints, these pains are known as "rheumatic." But a careful examination of the skeleton shows the joints to be often entirely unaffected, and that the points from which the pains really proceed are certain sensitive spots at the articular ends of the bones, especially bony prominences to which muscles are attached, a fact to which my attention was first directed by my colleague, A. Burger, of London. At this early stage no other changes are usually to be discovered in the affected bones. The pains may, however, be associated with a flat elevation at the place affected, to which the tenderness on pressure is limited. When this elevation is marked and situated on flat surfaces of bone, as on the top of the skull, or the inner surface of the tibia, a certain elastic resistance or a peculiar sense of fluctuation may be perceptible to the touch. After some length of time this gives place to an increasing hardness, so that finally a more or less even, *hard*, and *permanent* prominence is left behind. Such ossified prominences were termed by the old writers *tophi*,[1] and were distinguished from the gradually softening *gummy tumors* of the bones.

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[1] Gesamm. Abhandl., p. 595. Archiv f. Anat. u. Phys., B. XV. p. 262.

[2] Würzb. med. Zeitsch., B. IV. 1863.

The latter belong mostly to the later periods of syphilis, generally appear in isolated form, without other symptoms often, and the prominences grow pretty rapidly into roundish tumors, or, upon the top of the skull, remain flat. Only exceptionally, and then in connection with destructive, pustular eruptions, do these tumors occur in the acute stage of syphilis. They have a pretty firm, but elastic consistency when fully developed, and afterwards the course which they pursue differs in different cases: either resorption gradually takes place, which leaves a depression behind, surrounded by a hard wall-like rim, or else the tumor advances in the direction of the skin, which it perforates in the same way as the subcutaneous gummata. The ulcer resulting in the latter case is, however, not confined to the skin and subcutaneous cellular tissue, but from the very first begins to encroach upon the bone, the destruction of which commences before the perforation of the skin; different-sized pieces of very porous bone are thus exfoliated. Upon the top of the skull, especially, extensive destruction is often the result of this process, which may even go on to a perforation of the bone. If such ulcers heal, radiating, contracting cicatrices are formed, which are adherent to the irregularly nodulated surfaces of bone beneath.

These processes occur not only on the surface of the bone in the periosteum, they may also develop in the medulla. For a long time deep-seated, violent, boring pains in the bone are the only symptoms. Gradually the bone becomes swollen at a certain spot, or, it may be, in its entire circumference, where a thin, long bone is concerned, as the fibula, or one of the phalangeal bones of the fingers, and the like. Finally, only a thin, cortical shell surrounds the gummy tumor, yielding to pressure with crepitation ; at last it is broken through and the perforation of the skin soon follows.

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[1] *G. Fallopia*, l. c., "tophacei (sc. tumores) sunt constantes ex materia penitus lapidosa et videntur veluti tophi ossei vel materia illa qua ligantur ossa fracta."

It is this process which obtains in one form of the so-called *dactylitis syphilitica*,[1] where a roundish, nodular swelling of one phalanx gradually develops, and the skin over it becoming finally red, is broken through in one or more places, giving exit to a gummy-like fluid, mingled occasionally with lumps of whitish, caseous matter. This affection is not very common, and though occurring in adults, it is observed particularly in children with hereditary syphilis, in the first few years of life, and constitutes a variety of the so-called *spina ventosa.* Its outward appearances may be produced also by tuberculosis, enchondroma or sarcoma of the bone marrow.[2] Anti-syphilitic treatment is speedily efficacious in dactylitis syphilitica. In Bergh's and Morgan's cases a cure was soon brought about by the use of mercury, while in several cases of mine I have seen perfect recovery take place, within a few months, through the iodide of potassium.

In an eighteen months' old, well-nourished boy of healthy appearance, who had an induration, opening externally, of the left testis and epididymis, and slight hydrocephalus, there were developed upon the fifth metacarpal bone of the left hand, on one of the right metatarsal bones, and upon the lower end of the radius, swellings of the character above described. The one on the radius had opened. The child presented no other symptoms of syphilis. Complete cure followed the use of the iodide of potassium, within five months, an interruption of the treatment for several weeks having previously been followed by a renewed increase in the osseous swellings. The ulcer in the testicle healed much less rapidly than the ulcer in the radius, and both healed with sunken cicatrices which were firmly adherent to the parts beneath.

Dactylitis syphilitica does not always originate in the bone; similar appearances may be produced through gummous formation in the sheaths of the tendons and in the fibrous structures of the finger.

The syphilitic bone affections have certain special *points of*

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[1] Compare *Lücke*, Berl. klin. Wochenschr., 1867, No. 50 and 51.—*Archambault*, l'Union méd., 1869, No. 140.—*R. Bergh*, Archiv f. Dermat. u. Syph., II., 1870, p. 223. —*J. Morgan*, Med. Press and Circ., 1872, Dec., 1873, Jan., and Dublin Journ. of Med. Sci., 1873, April, p. 354.—*R. W. Taylor*, Arch. of Scien. and Pract. Med., New York, 1873 No. 4. : reference to in the Centralblatt, 1874, No. 5.

[2] *Virchow*, Die krankh. Geschw., II. p. 405. Comp. also pp. 6, 290, 703.

predilection. Such bones are first attacked as are covered only by the integument, and are thus more exposed to external traumatic accidents and to the changes of temperature, as, for example, the skull, the clavicles, the tibiæ, the ribs, and the sacrum. Then come the bony processes, as already mentioned, and especially the points of muscular attachment, which are subjected to a strain during contraction of the muscles. In contradistinction to these situations, bones which are enveloped in the soft parts are but rarely attacked; nevertheless, even the vertebral column is not always spared, and when this is assailed it must be esteemed a fortunate circumstance for the patient when bony elevations coexist in places accessible to inspection, thereby directing the physician's attention to the true nature of the affection, which might otherwise betray its syphilitic character by no sign whatever.

The most painful of the syphilitic bone affections are often the very slight periosteal swellings of the secondary period. The sensitiveness of the affected part may be so extreme that even the pressure of the bedclothes cannot be borne. Gummata, whether proceeding from the periosteum or the medulla, may run their course with but insignificant pains, or with pains which are violent and persistent—dolores osteocopi. The pain of syphilitic bone affections has the peculiarity of occurring with its greatest vehemence at night. During the day it may be totally absent. Ricord thinks that it is the warmth of the bed that causes the pains, and he makes the statement that persons who stay up during the night remain then free from pain, but suffer if they lie in bed during the daytime. It is very probably alterations in the fulness of the blood-vessels which either occasion or at least aggravate these pains; and another point which seems to me equally, if not more important, with respect to their cause, is the existence of an *evening exacerbation of the fever*, although it may be only slight in degree. It has seemed to me, in fact, that the patients who had fever complained more of periodically recurring pains than those in whom bone affections ran their course without febrile symptoms; and moreover, that the pains did not begin at so late an hour of the night as is generally stated—eleven o'clock—but commenced gradually to increase from the latter part of the afternoon.[1] And the fact of the pains ceasing with an attack of sweating in the early morning hours, as mentioned by numerous writers, speaks in favor of their connection with variations in the bodily temperature. This connection appears to me to be something as follows: Under the influence of the febrile rise in temperature the peripheral blood-vessels gradually dilate, and at the same time there is a determination of blood to those parts of the periosteum and bones which lie nearest the skin, a tumefaction being thereby produced in the places affected.

Anatomically all the syphilitic affections of the bones are owing to changes either in the *periosteum* or in the *medulla*, and indeed, whether the processes are irritative, hyperplastic, or gummous, they may develop in one as well as in the other of these situations.

The very painful though scarcely perceptible swellings which occur principally in the early periods of syphilis, as early often as the fever of eruption, though by no means excluded from the later periods, belong to a *simple periostitis*. This, after lasting for a certain length of time, leads to a deposition of new bone substance and to a thickening of the adjacent cortical portion—to a *hyperostosis*. In this way there are formed, especially upon the long bones, but on the skull also, often considerable elevations, which, after the acute process has spent itself, constitute the painless *tophi*. At first such portions of bone (or it may be, the whole extent of a long bone), are of ivory-like hardness; but, according to Virchow, medullary spaces gradually appear in the sclerosed portions in the same way as in the normal osseous development, so that in the course of time the thickened bone may become even more porous than natural. In this variety of the periosteal affection, suppuration occurs very rarely, though it doubtless might take place in the severe forms, such as are of much more frequent occurrence, according to C. Mauriac, in South America and Africa, and likewise in that form of the bone affection which has been recently shown by G. Wegner[2] to be peculiar to hereditary syphilis, of which it is a pathognomonic symptom.

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[1] Even *Fallopia* says: "XXII. Hora incipit dolor, non pervenit ad mediam noctem et clamor percutit auras." L. c., p. 781.

[2] Virchow's Arch., B. 50, 1870, S. 305.

This form of the bone affection occurs at the margins of ossification in the epiphyses and in the cartilage of the ribs. It was described by Valleix,[1] Bargione,[2] Ranvier,[3] and Guéniot,[4] but has only been carefully studied in the last few years by Wegner, Waldeyer and Köbner,[5] and Parrot.[6] Its course is marked by thickening of the periosteum, formation of osteophytes, and by a speckled discoloration and softening of the spongy tissue of the bone in the neighborhood of the epiphyses. The cartilage layer is enlarged and softened, the zone of ossification is thickened, and projects with irregular prolongations into the cartilage layer, the union of the two becoming thereby less firm, so that the epiphysis is liable to become entirely separated from the shaft of the bone, or the rib from its cartilage. Suppuration frequently takes place in the tissues surrounding such markedly altered bones, and occasionally in the adjoining articulation.

This affection generally exists in several bones at the same time, as may often be demonstrated at the autopsy, even though during life the affected extremity may apparently have been quite normal. Moreover, where changes to the naked eye appear exceedingly minute and insignificant, with the aid of the microscope they may be recognized as the characteristic marks of the affection—diminution or absence of the osteoblastema at the margins of ossification, and a filling of the medullary spaces with granulation—(gumma—) tissue. The knowledge which has been gained of this affection must be regarded as an extraordinarily valuable contribution to the diagnosis of inherited syphilis. It is not infrequently the only symptom of it, and, inasmuch as it begins even in uterine life, its presence may be demonstrated in still-born children as well as in those that live for several weeks. Whether it occurs also in children with hereditary syphilis, in whom the disease does not manifest itself until later, has not been determined, but it appears to be absent when the syphilis is *acquired* in infancy; at least Köbner,[7] in a case of vaccination syphilis, was unable to find any changes in either the cartilaginous ends of the ribs or in the epiphyses of the long bones.

Gummy tumors not infrequently develop in the periosteum in the later stages of the disease. Their development is slow, often attended with but little pain, and they may be either small and circumscribed, or (as upon the cranial bones, especially) their occurrence may be more diffuse. These periosteal thickenings have a lardaceous appearance on section, or they may be still softer, with the consistency partly of mucous tissue or pus, and are composed of a delicate, fibrillar groundwork, with round and spindle-shaped (or together with some stellate, branching) cells, frequently mingled with a finely granular detritus. In the early stages of the process it is impossible to fix upon any anatomical difference between a simple inflammatory or hyperplastic growth and gumma tissue. There are obviously transitional forms, since the gummy tumor differs only in the peculiar change which the cell-growth undergoes in its subsequent course, from the processes of the primary and secondary period which run their course more after the manner of a simple hyperplasia.

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[1] Bull. de la Soc. anatom. de Paris, IX., 1834, p. 169.

[2] Lo Sperimentale, Juli, 1864.

[3] Gaz. médic., 1864.

[4] Gaz. des Hôp., Feb. 9, 1869.

[5] Virchow's Arch., B. 55, 1872, p. 367.

[6] Archives de Physiol., 1872, Nos. 3, 4, 5.

[7] Arch. f. Derm u. Syph., B. III., 1871, p. 148.

The change which is wrought in the bone where these growths develop, and which was first accurately described by Virchow, is a double one. In the centre, an ulceration, a caries sicca takes place, which leads to a superficial excavation, and to a porous condition of the bone, while at the periphery, a hyperostosis is in progress, so that the central depression, which is often radiated or star-shaped, comes to be surrounded by a hard bony wall. During the extension of the process the periosteal hyperplastic growth can be lifted out of the depression, and its identity with gumma tissue has been demonstrated microscopically by Virchow.[1] Rindfleisch[2] has shown that the adventitia of the blood-vessels, in this instance also, forms the matrix of the hyperplastic growth. By this means the encroachment of the growth upon the bone tissue, with atrophy of the latter, is made explicable. After the hyperplasia has undergone complete resolution, the depression still remains, with the but little altered periosteum firmly adherent to it. The secondary changes at the periphery are not confined to the surface of the bone, but the subjacent spongy tissue, or, in the skull, the diploë, becomes sclerosed in like manner; indeed, effects may be seen upon the inside of the cranium, of a process taking place upon the outside, in the form of thickenings or osteophytes, and even upon the inner surface of the dura mater, in fibrinous or slightly hemorrhagic spots. This process may extend still farther inward, as illustrated by a case, the autopsy of which I witnessed at the German Hospital in London, June 9th, 1872:

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[1] Archiv. B. XV. p. 243.

[2] L. c., p. 568.

A man, about forty years of age, who for some time had suffered from dropsy, but in whom no syphilitic affection had been suspected, died rather suddenly in an attack of convulsions, which were said to have been confined to the face upon the right side. Besides amyloid degeneration of the spleen, liver, and kidneys, there were found certain marked changes in the cranium, namely, several roundish atrophic spots upon the outer surface of the calvarium, among which was a uniformly atrophied spot, the size of a silver dollar, in the left half of the frontal bone, near the mesian line. The cranium at this spot was thinned, and corresponding to the middle of this thinned place, in the dura mater, there was found a yellow, caseous patch, one mm. thick, and of the size of a twenty-five cent piece, to which the pia mater was firmly attached. The latter also could not be separated, without tearing, from the gray substance of the brain, which was somewhat softened and dotted with various-sized brownish-yellow points.

In *the medulla of the bone* the syphilitic changes also proceed from hyperplastic cell growths, as already mentioned with regard to the form occurring in hereditary syphilis. But while in the medullary cavities of the long bones the osteomyelitis appears in the form of circumscribed tumors, in the spongy tissue of the flat bones, and especially in the diploë of the cranium, it forms a sort of infiltration. The cell growth causes an enlargement of the canaliculi and lacunæ of the bone, and in this way it may happen that a piece of bone is entirely separated from its osseous union with the surrounding bone. Such an exfoliation occurs frequently upon the skull, and the sequestrum is marked by a great porosity, corresponding to the processes which led to its separation. The actual separation takes place in consequence of the purulent or muco-fatty disintegration of the gumma growth, and before this has progressed far, inflammatory processes commence in the layers above, which are soon followed by perforation of the skin. At the margin of the diseased bone there occur in this instance also, in the bone as well as proceeding from the periosteum, hypertrophic processes, sclerosis, and osteophyton formations. In small long bones the gummous formation in the medullary cavity causes a bulging of the bone, with gradual atrophy of the cortical substance, which finally encloses the growth as a mere thin shell; the most marked form of which is seen in the above-described dactylitis syphilitica.

We must mention, finally, the changes produced in the bone *secondarily*, through ulcerative processes in the overlying soft parts. Under this head belong especially the necroses of the bones in the nasal cavities and of the hard palate, which proceed mostly from ulcers of the mucous membrane; here belong also necroses of superficially situated bones, due to ulceration in the skin.

The *sequelæ* to syphilitic bone affections are of great variety. Not only may permanent disfigurements result, as, for example, a sinking-in of the ridge of the nose, bulgings of the facial bones, protuberances and hollows upon the forehead, but bones may be so impaired in their strength that fractures are produced upon the most trivial occasions (as observed in one case of the humerus, by Hutchinson,[1] and of the radius, by Volkmann); or, through defects in certain bones, the safety of vital organs may be imperilled, as that of the brain; or organs may have their functions seriously impaired, as on account of defects in the palate. Again, those bone affections which are attended with enlargement and hyperostosis may occasion symptoms of compression of vessels and nerves. Cases in which the latter are involved occur frequently, and are of great importance, particularly where the cerebral nerves suffer in this way.

In the *diagnosis* it is important, first, in any given case, to decide whether an existing bone affection is really syphilitic or not. The syphilitic are distinguished from other affections of the bones through their points of predilection, the nocturnal pains, the slight tendency to suppuration, and their disposition to hyperostosis and anastosis; in necrotic processes, on account of the porousness of the sequestrum and the slight reaction in the surrounding parts. Next, the form of the affection is to be ascertained, whether simple or gummous periostitis or gummous osteomyelitis; and here the relations as to time have to be principally regarded. Gummous processes proper, that is, such as tend to mucous softening, suppuration, or caseous degeneration, belong, with few exceptions, to the *tertiary* stage of syphilis; in the *secondary* stage, processes occur which undergo spontaneous resolution or lead to simple hyperostosis.

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[1] Lond. Hosp. Reports, Vol. III., 1866, p. 381.

There yet remains a single question to be alluded to, which for centuries has been revived time and again, namely, whether the bone affections which we have just described occur most frequently in those patients who have taken mercury, indeed whether they are not exclusively due to the action of mercury, and have nothing at all to do with syphilis. J. Grünbeck[1] as early as 1503, and again G. Fallopia (1555)[2] more particularly, ascribed affections of the bones to the use of mercury in the form of inunction, and the latter even claims to have found the metal in excised gummy tumors of the bones. But, on the other hand, U. Von Hutten (1519)[3] and L. Botallus (1563)[4] maintained that bone affections occurred in those also who had never taken mercury; and now, after the experiments of Overbeck upon animals, together with the profound studies of Kussmaul[5] concerning the hydrargyriasis acquired by workers in mercury, we may rest assured that, while caries and necrosis of the maxillary bones may take place in consequence of mercurial stomatitis, other bone affections, such as are observed in syphilis, are not produced by mercury.

LIGAMENTS, TENDONS, BURSÆ, AND JOINTS.

Syphilitic gummata sometimes develop in the FIBROUS CAPSULES AND LIGAMENTS of the joints, indicating their presence by tumors which are but slightly painful, though associated with more or less disturbance of function, depending upon their situation.

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[1] Comp. *J. K. Proksch*, Der Antimercurialismus. Erlangen, 1874, p. 10.

[2] Aphrod., II. p. 809.

[3] Ibid., I. p. 280.

[4] Ibid., II. p. 896.

[5] Untersuch. ub. d. constit. Mercurialismus. Würzburg, 1861.

According to Verneuil[1] and Fournier[2] the SHEATHS OF THE TENDONS either become the seat of mere circumscribed effusions, which form painless, occasionally fluctuating swellings, an affection which is not uncommon in women, chiefly in connection with the extensor tendons of the hands and feet, or inflammatory appearances are superadded, with all the symptoms of an acute tenositis—tumefaction, redness of the skin, tenderness, pain, and a sense of friction on motion. According to Fournier, the extensors of the thumbs, the tendons of the biceps and of the peronei, and the extensors of the fingers are the most frequently attacked, though the affection is also met with upon the ligamentum patellæ, the tendo Achillis, and in other situations. When the inflammation is situated near a joint, it may easily simulate an affection of the latter or of the periosteum, but a careful examination will almost always lead to the correct diagnosis.

But true gummata may also develop in the sheaths of the tendons. In a case of Munn's[3] a palish-yellow tumor, of the size of a half orange, formed above the tendons on the back of the foot, in a man forty-five years old, who for twenty years had been suffering from syphilis. The skin ulcerated, and the contents of the tumor were evacuated. Something similar had taken place over the tendons at the inner side of the knee some time before.

In the *bursæ*, also, serous effusions may take place, and the walls of the bursa, like the tendinous sheaths, may become the seat of a gummous growth.

Of more frequent occurrence than the affections just described are syphilitic diseases of the *joints*. Although not a few of the painful affections, appearing at first sight like joint affections, are found on closer examination to be inflammations of the periosteum, or affections of the ligaments or tendons, there still remain a number of cases of true disease of the joints, either of the subserous connective tissue and synovial membrane only, or even of the articular cartilage. It has been observed (p. 127) that, at the time of the eruption fever, articular pains, with serous effusion into the joint, together with inflammatory symptoms resembling an acute articular rheumatism, are not of very rare occurrence. Babington has called attention to the difference between this form, which generally occurs at the beginning of the secondary stage, and the chronic forms which develop without inflammatory symptoms in the later stages of the disease. The acute forms may, however, also occur later in the course of syphilis, as shown by two cases of Duffin's[1] and one which I[2] reported.

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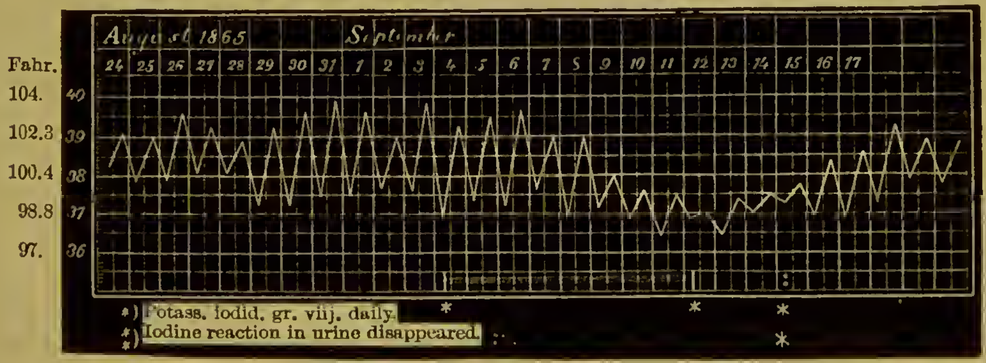
[1] Gaz. hebdom., 25, Sept., 1868, No. 39.

[2] Leçons, p. 703 ; Gaz., hebdom., 9, Oct., 1868, No. 41.

[3] Transact. Path. Soc. London, Vol. XVII., 1866, p. 437.

An exceedingly important and invariable indication (first pointed out by Duffin) of the syphilitic nature of such articular affections (which, by the way, may also be called "*syphilitic rheumatism*," or in case it is more of a periostitis or an affection of the fibrous structures outside the joint, Fournier's term, "*pseudorheumatism*," may be employed) is the *decidedly remittent fever*, which, together with the joint affection, responds with remarkable rapidity to anti-syphilitic treatment.[3] This is illustrated in the following tracing, taken from my work cited above:



The case was that of a person, twenty-eight years of age, who was suffering from ozæna, and had an old perforation of the hard palate, but presented no further symptoms of syphilis. She had been suffering for a few days from rheumatic symptoms, and at the time of admission there was a swelling of both ankle-, knee-, and elbow-joints, and of the left wrist and shoulder. There was profuse perspiration, as in rheumatism. The urine contained abundant albumen. Very small doses of the iodide of potassium had, in a few days, as appears from the tracing, a perceptible influence upon the course of the fever and upon the other symptoms as well, and when the remedy, on account of a diarrhœa, was interrupted, the temperature rose again at once. Further observations were precluded by the patient's leaving the hospital.

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[1] Transact. Clin. Soc. London, Vol. II., 1869, p. 81.

[2] Deutsches Archiv f. klin. Med., IX., 1870, p. 408, Fall 2.

[3] *Schuster*, Ueber Fiebercomplicationen bei Syphilitischen. Archiv f. Derm. u. Syph., B. V., 1873, p. 283, reports a case in corroboration of the above.

Sometimes the affection is confined to a single joint, and in case it is long persistent, it may be attended with considerable effusion—hydarthrosis. But even old joint troubles of this kind yield relatively quickly to anti-syphilitic treatment. I have seen several cases where patients had been confined to their beds for months with such articular affections of the lower extremities, and yet, by means of the iodide of potassium, regained the use of their limbs within a few weeks.

Of the *anatomical changes*, upon which the syphilitic joint troubles depend, we have very imperfect knowledge. In the acute form, post-mortem examinations are totally lacking. On the other hand, a few cases of chronic affection of the knee-joint have been examined by Lancereaux[1] and Oedmanson[2] who found a gummous growth in the subserous connective tissue at the side of the patella, together with secondary changes of the articular cartilages, in the form of superficial erosions; in the synovial membrane there was merely thickening and injection. Coulson[3] observed perforation into the knee-joint of a gumma, which had originated in its vicinity. In like manner—per contiguitatem—a joint may become the seat of inflammatory manifestations when a bone which enters into the composition of the articulation is attacked by a syphilitic affection, as in the above-mentioned instance of the peculiar epiphyseal disease in children with hereditary syphilis. Moreover, where a simple syphilitic periostitis occurs in the immediate neighborhood of a joint, an effusion may take place into the latter, since the subserous tissue and synovial membrane participate in the inflammatory fluxion to the part.

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[1] L. c., p. 203 s.

[2] Nordisk Med. Archiv, I., 4, 1869. Cited by *Bergh*, Archiv f. Dermat. u. Syph., II., 1870, p. 232.

[3] Lancet, 1858. Cited by *Lancereaux*.

MUSCLES.

Ricord, Clin. iconograph.—*Buisson*, Tum. syph. des muscles. Gaz. méd. de Paris, 1846.—*Notta*, Sur la rétraction muscul. Syph. Arch. gén., 1856, Dec.—*Nélaton*, Tum. syph. muscul. Gaz. des Hôpit., 1858, No. 6, 1861, No. 59.—*Virchow*, Archiv, B. XV. p. 282; Geschwülste, B. II. p. 437.—*Sidney Jones*, Transact. Path. Soc., Vol. VII., 1856, p. 346; Vol. XI., 1860, p. 246.—*Murchison*, Ibid., Vol. XIII., 1862, p. 250 (Diaphragma).—*J. Hutchinson*, Reynolds' System of Med., p. 304.—*Lancereaux*, l. c., p. 211.

Under the influence of syphilis the *muscles* may become diseased, either in a somewhat diffuse manner, or in the form of a subcutaneous myositis, accompanied by considerable pain on motion, and tending to atrophy of the muscular bundles and fibrous degeneration of the portion of muscle affected; or a gummy tumor may develop in the interstitial connective tissue or in the muscular sheath, consisting in its fresh state of an accumulation of single nucleated cells, in its later stages of amorphous, fine granular substance. In this latter case the muscular fibres are likewise destroyed. The course of the affection in the latter form is more insidious, pain is wanting, and frequently the contraction which characterizes the first form is also absent. Gummata of the muscles may also undergo softening, and break externally, after the manner of subcutaneous gummy tumors; intractable fistulous ulcers may thus result.

The syphilitic disease may locate itself in the most various muscles. The diffuse form has been found more especially in the flexors of the upper extremities, while the gummy tumors occur in the gluteus, trapezius, sterno-cleido-mastoideus, in the tongue, the muscles of the soft palate, and in the fleshy substance of the heart.

A gummy tumor of the muscle, grown to a large size, might readily be mistaken for a malignant growth, especially if it projects much above the muscle. But in cases even where other evidences of syphilis fail, we may always have recourse to the therapeutic test with the idodide of potassium[1] as an aid to the diagnosis.

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[1] As early as 1845, *Tatum*, in a paper read before the Med. Chir. Society in London, but which was not printed in their Transactions, called attention to the efficacy of the

THE LYMPHATIC APPARATUS.

Lymphatic Glands, Follicles, Tonsils, Spleen, and other so-called Vascular Glands.

Virchow, Archiv, B. XV. p. 315–20, Geschwülste, B. II. p. 416.—Lymphatic glands: *v. Sigmund*, Wien. med. Wochenschr., 1859, No. 23 u. 25.—*Fournier*, l. c., p. 613.—Spleen: *E. Wagner*, Archiv d. Heilk., B. IV., 1863, p. 430.—*A. Beer*, Die Eingeweidesyphilis. Tübingen, 1867, p. 24, 110, 134, 160.—*S. Gee*, Brit. Med. Journal, 1867.—*S. Wilks*, Transact. Path. Soc., Vol. XII., 1861, p. 216.—*W. Moxon*, Ibid., Vol. XXII., 1871, p. 274.—Suprarenal capsules: *v. Bärensprung*, Hered. Syph., p. 56.—*W. Moxon*, Guy's Hosp. Rep., Vol. XIII., 1868, p. 339.—*Huber*, Deutsches Archiv f. klin. Med., B. V., 1869, p. 270.—*Hennig*, Jahrb. f. Kinderheilkunde, 1872, p. 109.—Thymus: *P. Dubois*, Gaz. Méd. de Paris, 1850 et 1851.—*F. Weber*, Beitr. z. path. Anat. d. Neugeb. Kiel, 1852, II., p. 75.—*C. Hecker*, Verh. d. Berl. Ges. f. Geburtsk., B. VIII., p. 117, 122.—*Lehmann* Ibid., B. X., p. 29.—*Weisflog*, Beitr. z. Kenntn. d. Dubois'schen Thymusadscesse bei angeb. Syph. Inaug-Diss. Zürich, 1860.

Lymphatic Glands.—In the same manner as we saw the primary affection attended by an indolent swelling of the corresponding lymphatic glands, so we find the same occurring after infection of the entire system, when the syphilitic poison has caused multiple deposits throughout the body in which the virus becomes augmented. From the local affections of the skin, of the mucous membranes, of the bones, etc., the poison is conveyed in larger quantity to the next lymphatic glands, exciting in them the same changes which we have studied in the indolent buboes of the primary period. Thus, in connection with affections of the mucous membrane of the mouth, we find the submaxillary glands enlarged; with eruptions upon the hairy scalp, the cervical glands; with papules of the palm of the hand, or with paronychiæ, the cubital glands. But this is not the only way in which the lymphatic glands of all the different regions of the body are made to sympathize in the disease. It is probable that the poison circulating in the blood

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iodide of potassium in the treatment of muscular tumors. (Referred to by Prescott Hewett, in his Inaugural Address, as President of the Clinical Society. Transact., Vol. VI., 1873.)

may cause hyperplasia of the lymphatic glands directly, for sometimes we see these glands reacting to the poison before the skin or mucous membranes. The glands of the nape of the neck, those above the condylus int. humeri, or the small glands at the side of the breast often become enlarged before the skin eruptions make their appearance, or without any source of peripheral irritation being discoverable. Von Sigmund, who was the first to direct attention to the universal character of the glandular affection in the secondary period of syphilis, and to its great practical significance, is disposed to admit only this last mode of origin, observing that the glandular swellings precede the syphilides of the skin and mucous membrane, and are to be found in new-born children before any manifestations of the inherited syphilis have yet made their appearance. From this standpoint, however, it is still unexplained why, when the total volume of the blood contains the poison in sufficient quantity to irritate the lymphatic glands, this irritation manifests itself only upon certain ones; for that this is a fact I have been convinced by a number of observations, directed to this particular point; in many individuals who had been unquestionably syphilitic for some time, the glandular affection was absent from, certainly, a large proportion of the glands accessible to inspection; indeed, only here and there were certain glands or groups of glands found to be enlarged, and even the cubital glands were not affected with any such uniformity as claimed by Von Sigmund. The fact is, that the individual disposition comes here into account, and, while in one person it is the integument which reacts first to the irritation of the syphilitic poison, in another it is the lymphatic glands. It is, moreover, to be observed further, that, even with peripheral local lesions existing, the corresponding lymphatic glands do not necessarily become enlarged, and that in any two persons, the conditions in other respects being about the same, the glandular enlargements may be greater and more permanent in one than in the other. The tertiary local affections are said not to be attended by swelling of the glands, but yet it depends mainly upon whether these affections are accompanied with suppuration or not. In the former case the glands become tumefied as in any ordinary suppuration.

With regard to the secondary stage, I have a general impression that there is usually some intervening local lesion between the blood-poisoning and the glandular swellings. Berkeley Hill,[1] too, is of the opinion that this is more commonly the case. Sometimes the *lymphatic vessels* in the vicinity of these glands also become affected, feeling like hard cords.

This affection of the glands (which is peculiar to the secondary period, beginning to develop from the sixth week after the appearance of the primary lesion) attacks by preference those glands which have been already named, but most commonly of all the posterior cervical, in the vicinity of which an occipital or mastoidal gland is occasionally enlarged. Its occurrence in the lymphatic glands in the interior of the body, also, has been verified in post-mortem examinations by von Bärensprung[2] and Virchow. The course of the secondary affection is quite as protracted as that of the primary indolent buboes, from six to eight months passing before resolution begins; according to von Sigmund, the glandular affection may even last for a lifetime. Inasmuch as, when dependent upon local lesions, different glands may vary considerably in their development as to time, it is occasionally possible to find swollen glands here and there for years, although the course of development for any single gland is comprised within months.

Resolution is not the only issue in which the hyperplasia of the lymphatic glands may terminate. The cell-growth may exceed its usual limits, and swellings result like those of scrofula: and, as in the latter, suppuration or caseous degeneration may ensue. Fournier states that this process is pretty common, only it is frequently not referred to its real source. But the events just mentioned may assume a more peculiarly syphilitic character; the hyperplasia may take the course of a gumma, and a fluctuating tumor become gradually developed which does not contain pus but a gummy-like mucous fluid. Finally, in the later course of syphilis, the lymphatic glands, together with other glandular organs may, as shown by Virchow, suffer an *amyloid degeneration*.

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[1] L. c., p. 76.

[2] Die hered. Syph., p. 17.

A hyperplasia perfectly analogous to that which occurs in the lymphatic glands may be sustained also by the FOLLICULAR APPARATUS at the root of the tongue, in the tonsils, and on the posterior pharyngeal wall; and Virchow calls attention to the fact that where the cell-growth is tolerably abundant a disintegration, culminating in a sort of follicular abscess or ulcer, may be the result. The tonsils are especially apt to be the seat of such gummous ulcerative processes. Certain peculiar changes in Peyer's patches will be mentioned further on.

That the SPLEEN may become enlarged in the acute stage of syphilis has been already mentioned (p. 127), and Weil[1] has recently discovered that this enlargement may begin even during the primary period. The affection of the spleen is related, on the one hand, to that which occurs in this organ in other blood-poisonings, and, on the other, to the lymphatic glandular enlargements. It is probably purely hyperplastic in its nature, since it disappears rapidly under anti-syphilitic treatment. But where it has existed for a considerable time, an induration may doubtless develop in the hyperplastic spleen tissue. These events are the same as those described under Virchow's two anatomical forms of the syphilitic enlarged spleen, which he terms respectively the soft and the indurated.

Gummata are frequently observed, too, in the spleen. They appear in the form of isolated or quite numerous nodules, varying in size from a millet seed to a walnut, in a spleen that is, generally, enlarged. If they lie near the capsule, the latter becomes cloudy and thickened. According to Wagner, recent syphilomata are grayish-red in color, tougher than the normal tissue of the spleen from which they project; the older ones are gray, sprinkled with yellow, dryer and harder. The vessels of the spleen and its septa, within the growth, mostly disappear without any traces of them remaining to be seen, and it is the same way often with the Malpighian bodies, though in other cases they are present. In other respects the sharply defined, but not usually encapsulated tumor, shows the finer anatomical structure of the syphiloma, namely, the cellular hyperplasia, with various grades of atrophy and fatty degeneration, together with the formation of new connective tissue. In consequence of these processes a gradual shrivelling takes place, with cicatricial contraction, similar to what occurs in healed hemorrhagic infarctions. Zenker found numerous cholestearine crystals in a tubercle of the spleen, which was enveloped in a distinct fibrous capsule.

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[1] Centralblatt, 1874, No. 12.

Still other pathological changes in the spleen are regarded by different observers as related to syphilis. Thus A. Beer describes, besides a diffuse cellular infiltration of the arterial sheaths in the spleen, certain peculiar deposits, which he regards as very characteristic; they are paler than the normal tissue, from which they do not project at all, merge diffusely in the surrounding spleen tissue, contain but little blood and few cells, and, in the centre, consist of a finely granular material in which a few cells and nuclei are imbedded.

Gummous disease of the spleen can only be suspected during life when the tumor lies near the capsule, and through irritation of the latter, pain or symptoms of a circumscribed peritonitis are occasioned. The enlargement of the spleen which is usually present in the early stages of syphilis would only admit of the diagnosis of a hyperplasia; in the later periods it would be amyloid degeneration, which is very apt to occur in the tertiary stage and in the stage of syphilitic marasmus, in connection with amyloid degenerations of other organs.

Moreover, the rest of the so-called vascular glands—*the thyroid, the suprarenal capsules, the glandula pituitaria, and thymus gland*—occasionally present more or less characteristic changes in syphilis. In the THYROID GLAND Lancereaux found enlargement with varying degrees of fatty degeneration; gummy tumors have not been found in it, though they doubtless occur in the gland. pituitaria (Virchow, Lancereaux).[2] In the SUPRARENAL CAPSULES, besides enlargement and gumma-formation (Virchow, Moxon), a total fatty degeneration was found in one

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[1] Private communication, supplementary to a short reference to the reported case in the yearly reports of the Gesellsch. f. Natur- u. Heilkunde in Dresden f. 1851 u. 52, p. 15.

[2] *Gros* et *Lancereaux*, Affect. nerv. syphil. Paris, 1861, p 247.

case, by Virchow.[1] The THYMUS, an organ which gradually undergoes atrophy in developing children, can only be of interest in this connection in the fœtus or in infants—particularly, therefore, in cases of hereditary syphilis. P. Dubois was the first to call attention to the fact that in the thymus of new-born children, with inherited syphilis, collections of pus are to be found, with which, however, as Virchow observes, the ordinary secretion of the gland must not be confounded; and the question is suggested by Lancereaux, whether in these cases it was not really softened gummata which were present, since Lehmann in one case, has found a gumma-like formation in the thymus. Eberth[2] also found, besides abscess-like deposits, certain dry, caseous tubercles in this gland.

THE LIVER.

Dittrich, Prager Vierteljahrschrift, 1849, B. I. p. 1, 1850; B. II. p. 33.—*Gubler*, Mém. sur une nouvelle affect. du foie liée à la Syphilis hérédit. Gaz. med. de Paris, 1852.—*Budd*, Diseases of the Liver, 2d ed., 1857.—*Virchow*, Archiv, B. XV., 1858, p. 266.—*Frerichs*, Klinik d. Leberkrankh., 1861, B. II. p. 152.—*S. Wilks*, On Syph. Affections of Internal Organs. Guy's Hosp. Reports, 3d Ser., Vol. IX. 1863.—*E. Wagner*, Das Syphilom der Leber. Archiv der Heilkunde, B. V., 1864, p. 121.—*v. Bärensprung*, Die hereditäre Syphilis. Berlin, 1864. —*Virchow*, Die krankh. Geschw., B. II. p. 423. See further references in the last-named work; also in *Lancereaux*, l. c., p. 259.

The discovery of syphilitic disease of the liver, by Dittrich, marked a turning-point in the pathology of syphilis, since here properly began the study of *visceral syphilis*. For, although the earlier writers upon syphilis regarded the liver as the proper seat of the disease, this was a mere supposition, based upon dogmas of Galen, and had been attacked by Pr. Borgarutius (1566),[3] in consequence of the negative results which he had obtained from numerous post-mortem examinations. The pathological changes to which Dittrich was the first to attribute a syphilitic origin had been already described by Budd, and also by Oppolzer and Bochdalek, the former regarding them as due to the obstruction of dilated hepatic ducts with cheesy matters, while the two latter ascribed them to cancer of the liver, which had healed. In consequence of the numerous investigations which have since been made with reference to syphilis of the liver, we have learned that the forms of disease which, under the influence of syphilis, may attack this organ (though some of these affections are better known to us in their final stages than in their entire development) are the following:

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[1] Würzburger Verhandl., B. III., p. 368.

[2] Virchow's Archiv, B. 40, 1867, p. 326.

[3] Aphrod., II. p. 1127.

1. *Diffuse Infiltration* (Wagner's diffuse syphiloma)—a form which has thus far been observed almost exclusively in infants[1]—was first described by Gubler, and is marked by an increase in the size and weight of the liver. Its color resembles that of flint; the acinous structure may be more or less obliterated or, perhaps, quite indistinguishable to the naked eye, as was the case in the liver of a child, one month old, examined by Wilks:[2] The liver was increased in size, was flattened and very dense, and no traces of hepatic tissue were visible to the naked eye. Under the microscope, however, in spite of the extensive infiltration, hepatic cells and blood-vessels were found, presenting their normal appearance.

According to Wagner, in livers of this kind the connective tissue between the acini is found thickened in most places, some portions being in a state of simple hypertrophy, while others are studded with numerous cells and nuclei, which also appear within the acini, arranged in groups corresponding to the capillaries. Sometimes only connective tissue is seen. As to the hepatic cells themselves, they are at one time in their normal state, while at another they show various stages of molecular disintegration.

The state of things here, then, is quite analogous to what occurs in the syphilitic changes in the skin and other tissues, viz., there is a proliferation of cells from the connective tissue between the acini, or from the adventitia of the interlobular vessels, and this growth may become transformed into connective tissue.

2. In a more circumscribed form this variety is doubtless of commoner occurrence, and particularly in adults. Since the pro-

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[1] *Wagner*, l. c., p. 145, describes a case in a man fifty-four years old.

[2] Trans. Path. Soc., Vol. XVII., 1866, p. 167.

cess runs the course of an interstitial hepatitis, it is usually recognized only by the cicatrices which it leaves. But in most of the cases, if the process has reached a considerable extent, the larger masses of cicatricial tissue are found to include portions of tissue which have undergone cheesy degeneration, similar to those left by true gummous hepatitis, which, from the first, occurs more in the form of circumscribed tumors. It is possible that such cheesy tubercles may gradually decrease in size by resorption of the fatty material, and thus, with the interstitial hepatitis, lead the way to those very remarkable changes in form which are sometimes observed in the liver. By means of deep cicatricial contractions, the organ may be divided into a number of distinct, roundish lobes or prominences, the liver becoming often much diminished in size, or it may be reduced to a roundish, nodular mass, not larger than the fist. When cut, dense bands of fibrous connective tissue, that grate under the knife, are found, corresponding to the external constrictions, and at some points they may enclose masses, which have undergone cheesy degeneration. The intervening hepatic tissue is either of normal character, or frequently in a condition of vicarious hypertrophy, or sometimes in a state of amyloid degeneration, and this degeneration may be limited to particular places, and be of such a high grade as to resemble gummy tubercles, as described by Virchow,[1] Grainger Stewart,[2] and Moxon.[3]

As a rare consecutive affection, partial acute yellow atrophy may develop in livers of this kind (Andrew,[4] Hilton Fagge).[5]

The peritoneal coating of such a liver shows, besides the constrictions, traces of perihepatitis, in the form of thickenings or adhesions with the diaphragm, the anterior walls of the abdomen, or with some of the other abdominal viscera.

3. The true *gummy tumor of the liver* (the large nodular syphiloma of Wagner) usually presents an irregularly circumscribed mass of connective tissue, from which prolongations

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[1] Geschw., II. p. 430.

[2] Brit. and For. Med.-Chir. Rev., 1864, p. 512.

[3] Trans. Path. Soc. London, Vol. XX., 1869, p. 431.

[4] Ibid., Vol. XVII., 1866, p. 158.

[5] Ibid., Vol. XVIII., 1867, p. 136.

often extend into sound hepatic tissue, with grayish-yellow cheesy deposits scattered through it, which are more sharply defined, the denser the connective tissue has become. Sometimes, however, it takes the form of a well-defined tumor of a roundish form, enclosing a dry, firm, cheesy matter in a fibrous capsule. Deposits in the midst of dense masses of connective tissue are most apt to occur beneath the suspensory ligament, from which a broad fibrous mass often extends through the entire thickness of the isthmus between the two lobes of the liver. Virchow calls attention to this, and he observes that it has an appearance as though the traction of the heavy organ upon its supporting ligament exerted a strain upon the tissue which had had some influence upon the development of these changes.

As a rule, gummy tumors in the liver are isolated, but it is possible for their number to be very large, and when this is the case they present the utmost diversity as to size, varying from that of a millet-seed (miliary syphiloma, Wagner) to that of a walnut, and are even greater. They were very numerous in a case observed by Prof. Zenker[1] in Dresden in 1851, of which he has had the kindness to give me a full report.

In the liver of a man, forty-one years of age, upon whose skull and shoulder-blades were also distinct marks of syphilis, were found, especially upon the right lobe, numerous round tumors of a size varying from a pea to a moderate-sized apple, which were for the most part spherical, but in many cases were aggregated in masses of irregular shape. With the exception of two large, soft tubercles, which contained a pultaceous substance enclosed in a dense fibrous capsule, they were very hard and dry, of a yellowish-white color, and in a few of them a distinct, concentric lamination was visible, and it was possible even to peel off the substance in concentric layers. The tumors were separated from the normal hepatic tissue by a pale gray fibrous capsule of considerable thickness, some of them being of a homogeneous consistency, while others showed at the centre of the yellowish-white substance, or in some part of the periphery, one or more irregularly shaped, pale grayish-red spots, which in comparison with the rest of the cut surface were somewhat depressed and softer, but much tougher. In some of the tumors very small calcareous concretions were also found. One tubercle was discovered in the spleen, of the same appearance as the tumors in the liver.

Under the microscope the pultaceous contents of the softened tubercles were found to consist mainly of finely granular corpuscles, resembling pus-cells but yet not perfectly round, of free fat, fat cells, and cells with fatty nuclei. In a light yellow mass which lay in the midst of one of the reddish gray spots, fat cells and numerous small acicular crystals were found. These reddish gray spots presented the appearance of indistinct fibrillation, with a few scattered islands of small corpuscles of irregular form, and not strongly refracting the light. At the boundary of these two substances were found a great number of non-transparent, large, round cells, from which issued, on pressure of the specimen, a quantity of short, needle-like crystals, while more deeply in the yellowish-white matter these cells were found more isolated. In addition to this, the tubercles everywhere contained a large amount of amorphous, finely granular matter.

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[1] Citat. on p. 184.

So far as the more essential microscopical characters of these tumors are concerned, they have already been given in the above description. While in the yellow spots it is possible only to demonstrate a finely granular detritus within a fibrous substance, towards the periphery, nuclei often appear, and sometimes cells, which anastomose in a reticular form. The development of these tubercles probably proceeds from the interlobular vessels, as stated above with regard to the diffuse affection. Corresponding to this, too, the tumor does not develop regularly and present a rounded surface on all sides, simply crowding the hepatic tissue away, but it grows into and between the acini in such a manner that liver tissue is sometimes surrounded and shut in by it. A very accurate description of the microscopic appearances is given by J. F. Payne,[1] and he makes it appear probable that gummata can continue to grow at the periphery, on account of the continued proliferation of the nucleated interstitial and interlobular tissue, while at the centre they have already become amorphous, and in the intermediate layer have degenerated into fibrous connective tissue. Payne calls attention to the fact that the growth has but little vascularity, and in this respect is in marked contrast with the ordinary interstitial hepatitis (cirrhosis).

The study of the larger tubercles in the earliest phases of their development has not been more closely pursued, because as a rule, they are only met with at autopsies after the processes have run their entire course. One of the earliest steps of their development is shown in von Bärensprung's first plate, which represents the liver of an infant which was probably prematurely born and which lived but sixteen hours.

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[1] Trans. Path. Soc., Vol. XXI., 1870, p. 207.

"The liver is of a bright red color, but with dark, greenish-brown spots, which are sharply defined, and some of them are round in form, while others have an irregular kidney shape, occasioned by the coalescence of one with another. In these spots are seen numerous white granules, which are as large as corn-grits, and slightly prominent. The liver is large and flabby; on section, it is of a reddish-yellow color, but also spotted, since the spots noted on the surface extend one or more lines in depth into the substance of the organ. Roundish deposits are also seen, which do not reach the periphery, are of a greenish-yellow color, surrounded by an area of marked hyperæmia, and at some portions contain also the white granules mentioned above. These last show, under the microscope, a finely granular, molecular mass, while at the discolored spots there is everywhere an abundant proliferation of cells and nuclei between the liver cells, which have been pushed aside and have in part disappeared.

A case observed by H. Weber,[1] in an adult, communicated by him to the London Pathological Society, and which I had the opportunity of examining with him, presents certain points of outward resemblance to the case just described.

C. F., a ship-carpenter, aged twenty-eight years, lay from December 21, 1865, until January 10, 1866, in the German Hospital in London, suffering from rheumatism. The elevation of temperature was only moderate, but to the other symptoms were soon added great depression of the sensorium, pain in the head, stiffness of the neck, slowness of the pulse, and on the 7th of January a state of coma supervened, from which the patient could be aroused only with great difficulty. On the next day it was no longer possible to arouse him, and death occurred on the evening of the 10th.

At the autopsy the head presented nothing abnormal externally, but upon opening the calvarium, firm adhesions were found between the dura mater and portions of the frontal, temporal, and parietal bones. These having been torn away, the internal table of the skull presented a worm-eaten appearance, and was covered with small osteophytes. Along the venous sinuses was found a growth of very vascular spongy tissue, a portion of which remained upon the dura mater. This membrane, so far as these portions were concerned, was considerably thickened, and numerous ecchymoses were found upon it, while the other membranes were slightly adherent to the dura mater, were somewhat opaque and thickened, but left a smooth surface when separated from the brain. A microscopic examination revealed in the growth on the dura mater, large cells and nuclei, which had undergone some fatty degeneration. In the brain substance no changes were discovered with the exception of some hyperæmia and ecchymosis of the pons and the crura cerebri. The liver was of normal size, but copiously studded with tubercles of large and small size, but for the most part of a round form. At the middle of those tubercles, which reached the surface of the liver, a depression was seen, and the centres, which were of a darker color and strongly injected, were surrounded by a wall varying in width from 0.05 to 1 cm. in thickness, and of a more yellowish tinge. In such parts of the liver as were apparently in a normal condition, examination with the microscope showed the hepatic cells to be enlarged, and filled with a finely granular substance, but the arrangement of the liver cells at the edges of the tubercles was normal. Toward the edge of the yellow zone there was an increase in size of the liver cells, as well as in the quantity of granules contained by them; while at the edge of the tubercles the cells appeared to be pressed closer together, and between them was a dark granular substance, and some large cells and free nuclei. Finally, in the very vascular centre there were but few hepatic cells, and between them was a growth of spindle-shaped cells, which were to some extent granular, some of them having very long processes.

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[1] Trans. Path. Soc., Vol. XVII., 1866.

The condition of the lungs was quite remarkable, both their surface and the parenchyma being traversed with a network of lymphatic vessels, which appeared as if injected with a milky fluid.[1] Some of the bronchial glands presented evidence of degeneration. In these, as well as in the contents of the lymphatic vessels, were found large cells, mostly round in form, but also spindle-shaped, with a sharply defined contour, and containing one or two strongly refracting nuclei. In the lymphatic vessels and glands were seen numerous fatty granules and much free fat.

The spleen and kidneys, with the exception of some contracted cicatricial spots upon the last-named organs, were healthy.

In addition to the changes noted in the cranial bones, there was a flat periosteal growth on the posterior face of the sternum; but, with these exceptions, there were nowhere either bony elevations or gummata, nor were any traces of ulceration found on the skin. The diagnosis of syphilis, in the absence of all anamnestic signs, rested upon the presence of scars upon the palatine arches, enlargement both of the follicles at the root of the tongue, and also of the inguinal, cubital, and cervical glands, together with a small scar upon the penis. The testicles were found to be entirely normal.

The disease of the liver had run its course without giving rise to a single symptom.

The changes in the liver in this case present so little resemblance to those observed in other cases, that, in spite of the many circumstances favoring the supposition, I am not fully convinced that they were due to syphilis. The appearances found in the above case differ from those usually present in cases of syphilitic origin, from the fact that round and spindle-shaped cells were present of much larger size than are commonly seen in gummy tumors. The fatty degeneration, too, was more marked at the periphery of the tubercle, while in cases of undoubtedly syphilitic origin this change is usually found to be in its most advanced stage at the centre. In fact, the description of this case, when considered in all its bearings, suggests some form of sarcoma rather than syphilis. But inasmuch as the early stages of syphilitic affections of the liver have been so little studied, it is worth while to note this case, although as yet it stands alone and its real nature remains doubtful, in order to compare it with others of a similar character which may be observed hereafter.

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[1] *W. Moxon* describes a similar condition, which he found in a case of pneumonia, in which there were also typical gummata of the liver, and a peculiar hemorrhagic affection of the spleen. Trans. Path. Soc., Vol. XXII., 1871, p. 274.

Softening of gummata of the liver must be regarded as of exceedingly rare occurrence. With the exception of Zenker's case, detailed above, I am acquainted with but one other, which was reported by Moxon,[1] and in which the inner portion of some of the tumors had the consistence of brain, and some perforations into the hepatic ducts had occurred.

4. *Amyloid degeneration* of the liver, in consequence of syphilis, may involve the whole organ, as well as portions of it, as already described. This change usually starts from the small interlobular branches of the hepatic artery, and it may, in fact, be limited to the coats of the arteries. It is always associated with amyloid degeneration of other abdominal organs, as the spleen and kidneys.

The signs of syphilitic disease of the liver are, as a rule, so vague that changes of a high grade may be found upon the cadaver, without a single symptom during life having pointed to the existence of hepatic disease. Especially is this true of gummata of the liver, which in many cases run their course without giving rise to any symptoms whatever. On the other hand, no pathological changes have as yet been found to account for the icterus, which occurs in the secondary period of syphilis—usually, in the eruptive stage. Gubler[2] was the first who attempted to prove that this form of icterus was not an accidental complication, but a characteristic symptom of syphilis, and he asserts that it appears either with the first syphilitic eruption or with the later relapses. As a rule, it is not very marked, nor does it continue for any great length of time, so that we can scarcely attribute it to a compression of the gall-ducts from a syphilitic cell-growth. It is more rational to look upon it, with Gubler, as a congestive icterus due to hyperæmia of the liver, or it may be regarded as a simple catarrhal jaundice, which develops under the influence of the fever, in the same way as the catarrh of the stomach, which is sometimes present. Lancereaux alludes to the possibility of its being due to a swelling of the lymphatic glands at the transverse fissure of the liver. However, it should be observed that icterus at this period of syphilis may also be a matter of more serious import. Goodridge[1] reports a case of acute yellow atrophy of the liver in a man twenty years of age, two months after infection, while roseola and the syphilitic affection of the throat were still present.

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[1] Trans. Path. Soc., Vol. XXIII., 1872, p. 153.

[2] Mém. de la Soc. de Biologie, 1853. Gaz. méd. de Paris, 1854. (*Lancereaux*, l. c., p. 149.)

The symptoms of the syphilitic affections of the liver, whose *morbid anatomy* has been ascertained, are referable to the changes in the size and form of the organ, to derangements in the portal circulation and in the escape of the bile, and, finally, to involvement of the peritoneal coating. Whether any or all of these symptoms display themselves, depends entirely upon the location of the process. The increase in size of the liver is a constant symptom in the diffuse hepatitis, both of hereditary and acquired syphilis, and also in amyloid degeneration, when it involves the entire organ. If, in the progress of the disease, interstitial contraction takes place, symptoms of cirrhosis of the liver will be developed. When a circumscribed formation of tubercles (gummous formation) takes place, the gradual change in shape of the liver—the lobulation of its tissue—becomes one of the most marked symptoms, and, according to the seat of the process, icterus or ascites, together with other evidences of a disturbed portal circulation, will be present. The diagnosis of a syphilitic cirrhotic liver, especially in patients of advanced age or who suffer from marasmus to a marked degree, may be attended with some difficulty, since the projecting nodules upon the surface of the liver bear a marked resemblance to those which occur in cancerous disease. As a rule, however, a syphilitic cirrhotic liver at this stage of the disease is smaller than normal, while a cancerous liver is apt to be enlarged, and by careful observation the increase in size may be verified. Moreover, the rest of the symptoms, especially the marasmus, increase with great rapidity if the disease is cancerous, but if these symptoms owe their origin to syphilis, they are apt to remain stationary for a long time. Of more importance, of course, in making a diagnosis, is the discovery of other symptoms pointing to syphilis, or at least evidences of their former existence.

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[1] Brit. Med. Journal, 1871, Vol. I. p. 609.

Implication of the peritoneal coating of the liver may be recognized by the pain in the hepatic region. In new-born children, unless, possibly, there may be some enlargement of the liver, the only local symptoms, often, are those due to the peritonitis—the screaming, drawing up of the legs, and vomiting. In these cases it is not rare for the peritonitis to become diffuse.

DIGESTIVE TRACT.

Mouth and Fauces, Tongue: *M. Kohn* (Kaposi), l. c.—*v. Sigmund*, D. papul. Syphilid am weichen Gaumen u. d. Mandeln. Oesterr. Zeitschr. f. pract. Med., 1858, No. 35.—*Lagneau*, Des tum. gomm. de la langue. Gaz. hebdom, 1859, Nos. 32, 33, 35. Archiv. gén., 1860, I., p 361.—Teeth: *Marston*, Med.-Chir. Transact., vol. 45.—*J. Hutchinson*, Trans. Path. Soc., Vol. IX., 1858, p. 449. Ibid., Vol. X., 1859, p. 287.—*Nunn*, Ibid., vol. XII., 1861, p. 239, Vol. XIII., 1862, p. 258.—*J. Hutchinson*, A Clin. Memoir, etc., 1863, p. 203 s.—Œsophagus: *S. Wilks*, Guy's Hosp. Rep.—*West*, Dublin Quarterly Journal, Feb. and Aug., 1860.—Intestinal Canal: *E. Müller*, Ueber. d. Auftreten d. constit. Syph. im Darmkanal. Inaug.-Diss. (*Dittrich.*) Erlangen, 1858.—*Meschede*, Virch. Archiv, B. 37, 1866, p. 565.—*E. Wagner*, l. c., IV., p. 368 u. 370.—*Förster*, Würzburger Med. Zeitschr., B. IV., 1863, p. 8.—*Eberth*, Virchow's Archiv, B. 40, p. 326.—*Schott*, Jahrb. f. Kinderheilk., 1861.—*Roth*, Virchow's Archiv, B. 43, 1868. p. 299.—*Oser*, Archiv f. Derm. u. Syph., B. III., 1871, p. 27.—*Schwimmer*, Ibidem., B. V., 1873, p. 247.—Rectum: *Gosselin*, Archiv. gén., 1854, II., p. 666.—*v. Bärensprung*, Ann. d. Charitékrankenhauses, B. VI., p. 18.—*E. Huët*, Behrend's Syphilidologie. N. Reihe, B. II., 1860, p. 1.—*J. Paget*, Med. Times and Gaz., 1865, I., p. 279.—

A. Behr, Eingeweidesyphilis. Tübingen, 1867, p. 7.—Discuss. in the Soc. de chirurg. de Paris, Jan., 1873. (A. Guérin, Després, Verneuil.) Gaz. hebdom., 1873.

The MOUTH and FAUCES may not only be the seat of the primary infection, but they are also the localities which are most frequently affected in the secondary and tertiary periods of syphilis. The elementary forms of these affections have been already described (pp. 137 et seq.), and it is here only necessary to call attention to certain peculiarities which are derived from the locality.

In the secondary period, superficial erosions or considerable ulcerations are common on the inner side of *the lips*, and they are especially apt to occur when an irregularity of the teeth keeps up a constant irritation at one spot. In the advanced stages of secondary syphilis, the above-described *plaques opalines* occur upon the mucous membrane of the lips and cheeks, and are often very obstinate affections. In the posterior portion of the mouth, the parts just in front of the half-arches, and between the upper and lower last molar teeth, are most commonly the seat of changes in the mucous membranes, which are most apt to take the form of papules. Small erosions occur also frequently on the gums, back of the central incisors of the upper jaw. During the administration of mercury, the swelling of the gums due to this drug, in conjunction with syphilitic changes in the mucous membrane, may add much to the discomfort of the patient. In some of these cases, it is not an easy matter to decide exactly what is due to mercurial stomatitis, and what to syphilis.

The TONGUE, during the period of eruption, especially when there is a papular eruption on the skin, is the seat of round, circumscribed, slightly elevated spots, which frequently extend at the periphery, assuming a ring or horse-shoe shape. At the borders of the tongue, above and below, isolated erosions occur, having the form of small fissures, which are often caused, or at least maintained, by sharp edges of the teeth; and when these are present the fissures may be converted into crater-like ulcers, of greater or less depth, with hard, gray edges. Small papules, too, often occur at or near the tip of the tongue, appearing as very late relapses, and often having the form rather of a small, red surface than of a red papule. When these papules occur in great smokers (in whom, in fact, they are generally found), they are extremely slow in disappearing.

At the anterior portion of the tongue the papules are usually flat, and even sometimes seem to sink beneath the level of the surrounding mucous membrane, having the appearance of bright shining spots, deprived of their epithelium, and in this respect present a certain analogy to papules upon the palm of the hand. But at the back part of the tongue the papules project more prominently, and, becoming confluent, form large, elevated condylomata. Some of the follicles at the base of the tongue may be swollen at the same time, or they may even become converted into elevated papulæ. Under unfavorable circumstances, particularly in patients who have defective teeth and are not careful to cleanse them, the entire tongue may be covered with papules, and look as though covered with a grayish membrane, showing the impressions of the teeth at the sides.

The tongue may, however, be the seat of disease at a later stage of the syphilis, since gummata may also develop here. A tumor of this character may develop out of an ulcer, which, though at first superficial, has long been subjected to the constant irritation from the sharp point of a tooth. More commonly, gummata originate in the substance of the tongue, beneath the mucous membrane, or in the intermuscular connective tissue, in the form of tumors varying from the size of a pea to that of a hazel-nut, which gradually increase in size and approach nearer the surface till they finally burst and leave an ulcerating cavity.

Before these tumors break, they annoy the patient more on account of the interference with the free motion of the organ than from the pain, and may then be easily confounded with cancer of the tongue. The points of distinction, as commonly stated, are the greater amount of pain and the more marked swelling of the lymphatic glands in cancer, and these sometimes suffice to make the diagnosis clear; but it is often difficult to decide the question, for after a gumma has broken it may become painful. Under these circumstances the result of treatment alone can be depended upon to clear up the point. Finally, there remains the possibility,* to which Hutchinson[1] calls attention, that a cancerous affection may develop from syphilitic ulcerations of the tongue.

The TEETH are sometimes lost in consequence of syphilitic disease of the gums; but their loss is more usually due to stomatitis, resulting from the injudicious use of mercury. It appears, however, that disturbances in the nutrition of the teeth may be due entirely to syphilis, and not to the abuse of mercury. Marston[2] describes a very peculiar decay of the teeth, in a soldier affected with syphilis, which could not be ascribed to mercurial stomatitis: About one and three-quarter years after infection, there made its appearance upon the superior lateral incisors a dark spot, which soon became a carious cavity, increased in size and separated the crown of the tooth from the root. The patient lost his upper teeth in this way, and those of the lower jaw began to be affected in a similar manner.

Syphilis causes *various deformities in the upper central incisors*, a fact which was first noticed by J. Hutchinson, and by him brought forward as a diagnostic mark of an antecedent inherited syphilis. Hutchinson has shown that children affected with hereditary syphilis frequently suffer in their earliest infancy from a stomatitis due to that disease, and that, in consequence of this, the development of the permanent incisors is hindered. This arrest of development makes itself manifest, soon after the appearance of the teeth, in a very characteristic deformity. Children affected with hereditary syphilis, who do not have the stomatitis which we have mentioned, do not exhibit this deformity.[3] It is therefore necessary to its occurrence that there should be a certain intensity in the manifestations of hereditary syphilis, and, in accordance with this view, Hutchinson asserts that this change in the teeth is usually found only in young children, conceived soon after the infection of the parents; those born later have symptoms of a lighter grade, and do not have the characteristic syphilitic teeth. It is not possible for the milk-teeth to be involved in this affection of the jaw, since they are formed in the earlier months of life; but an inflammatory affection or a cellular infiltration of the soft parts of the jaw may readily influence the early growth of the permanent teeth, which are still quite soft, especially in the peripherical portions, that is in, the enamel. The incisor teeth, since they are the most advanced in their development, are therefore in the most danger, and were investigation especially directed to this point, it would be ascertained why the upper central incisors are the teeth which are almost exclusively affected. These teeth are either stunted in their growth, or more frequently their lateral borders, instead of being parallel, are convergent, and there is a defect in the development of the central portion of the free edge, which is often serrated (Fig. 1).[1] This central portion soon becomes worn off by use, and the edge of the tooth then presents a slight concavity. After the tooth is fully developed it has a wedge shape, with a roundish notch in the free edge (Fig. 2), and is usually shorter than the adjacent lateral incisors. In consequence of the convergence of the sides of the teeth there is usually a considerable interspace left.

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[1] London Hospital Reports, Vol. III., 1868, p. 385.

[2] From H. Lee, l. c., p. 481. Marston states further that Dr. Roberts, in Manchester, and Dr. Todd have seen similar cases.

[3] Lond. Hosp. Rep., Vol. II., 1865, p. 145.

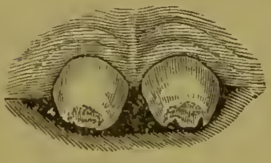

FIG. 1.

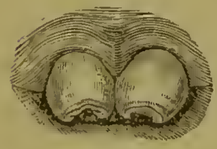

FIG. 2.

This very characteristic deformity, due to hereditary syphilis, does not appear to occur with equal frequency in different countries, being much more commonly found in England than in Germany. From statements upon this point which appear in German works, it is evident that the authors have not seen this affection in its typical form.

The ISTHMUS FAUCIUM is one of the principal seats of syphilitic disease. The earliest and least severe of the syphilitic cutaneous eruptions are accompanied by an erythema of the soft palate and pillars of the fauces, and soon, either accompanying a roseola or some other syphilide, graver and more characteristic lesions make their appearance upon these parts. These lesions are either superficial erosions which often occupy a considerable space upon the soft palate, or, more frequently, mucous patches, which, however, are rarely seen in the form of round elevations, but more frequently as gray thickenings in the form of ridges, which may border the free edges of the arches of the palate as far as the uvula, and sometimes, indeed, may cover the uvula also to a greater or less extent. These growths usually undergo a superficial disintegration, and in exceptional cases there is deep ulceration, and the affected portions then look as if gnawed out, and have a gray unhealthy appearance. It is rare, however, for extensive loss of substance to occur under this form of the disease, some little depressions only usually remaining, though the ulceration may possibly destroy the base of the uvula. These affections leave behind them very superficial cicatrices, with but slight contraction, so that even after extensive processes of this sort only slight changes are produced, frequently leaving only a slight bending of the uvula or a deflection to one side or the other.

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[1] These two cuts, as well as a third, which is given below, are taken from Hutchinson, and are used with his permission.

The tonsils, when superficially affected, are most commonly the seat of mucous patches, which are very apt to become disintegrated, giving rise to ulcers of greater or less extent, which are frequently quite deep and crater-shaped. Ulcers of this kind have irregular edges and a grayish (lardaceous) appearance. But the tonsils, which consist of a conglomeration of follicular glands, suffer other changes during the secondary period of syphilis. The tonsil increases in size, from swelling of the follicles and hypertrophy of the intervening tissue, and projects as a round, hard tumor, which is intensely red and shining; differing from the ordinary form of chronic hypertrophy only in its redness and smoothness. I have, several times, seen this form of hypertrophied tonsil in secondary syphilis, in conjunction with papules in the palms of the hands. Some of the follicles of the gland may become filled with a mass of yellow detritus, and thus present the appearance of a tonsil, hypertrophied in consequence of acute catarrhal inflammation. Tonsils which are thus affected by syphilis gradually diminish to a certain size, but always remain somewhat larger than they normally were. Sometimes they show a delicate whitish or bluish-white coating, or spots of a roundish or irregular shape, which resemble the *plaques opalines* of the mucous membrane of the mouth. On tonsils which had been for a long time the seat of syphilitic changes I have several times seen, after the lapse of years, superficially situated cysts, looking like atheroma cysts, filled with fatty detritus, and varying in size from a lentil to a pea.

It is not yet definitely settled whether gummata occur in the tonsils in the form of large, circumscribed tumors or not. It is to be supposed that they would occur, from the fact that, in the vicinity, submucous gummata undoubtedly develop. Sometimes a part of a tonsil is seen to swell to a considerable size, and then rapidly become disintegrated, giving rise to an irregular, ragged ulcer, with swollen and intensely red edges, which spreads both in circumference and in depth. But such ulcers also occur, sometimes, in the secondary period, without similar processes taking place elsewhere, and they occur also in non-syphilitic cases, in consequence of acute inflammation of an hypertrophied tonsil, in a form that might readily be confounded with that under discussion. I have often seen, in young people who were not syphilitic, but had hypertrophied tonsils, a part of one of the glands—usually the most prominent one, and in one case a projecting portion that remained after an excision of the tonsil—begin rapidly to ulcerate, in the manner just described, with the production of an ulcer, which on account of its ragged, purulent base, and bright scarlet and swollen edges, resembled very closely, for some days, a syphilitic ulcer of the tertiary period. A few days more served to show the real nature of these ulcers, for under simple treatment they soon took on a more healthy action and cicatrized. Such cases are especially liable to cause an erroneous diagnosis, since ulcers of the tertiary period may also be confined to one tonsil, and it is therefore always advisable to examine the patient with particular care.

At an early period of syphilis, in those who are of bad constitution, with pustular eruptions upon the skin, ulcers may form in the throat which resemble those just described, and which are distinguished from the common forms (which originate in thickenings of the mucous membrane, remain superficial, and run a chronic course) by the rapid purulent disintegration accompanying them. In the course of a few days the uvula, part of the soft palate, the palatine arches, or the tonsils may be destroyed. This ulcerative process, however, always extends to the parts on both sides of the fauces and pharynx, while those ulcerations which belong to the tertiary period, are more local in their character and are limited to one tonsil or to one side of the palate.

Gummata of the soft palate are sometimes visible as round prominences before they ulcerate. But they may also emerge and ulcerate upon the upper side of the palate, in the posterior nares, and then, on looking into the mouth, nothing is seen but a diffuse swelling of the soft palate.

Under these circumstances, by the use of the rhinoscope, it is sometimes possible to see the place where the gumma has broken, or the ulcer which has resulted from it.

The mucous membrane of the PHARYNX is usually implicated in the erythema of the early affections of the skin and mucous membranes. Sometimes, papules are also situated here, which are usually in the form of round, smooth elevations, having the typical appearance of flat condylomata. I once saw a condyloma of this character, on the posterior wall of the pharynx, and opposite to it, one, upon the posterior surface of the epiglottis. If mucous patches are situated at the orifice of the Eustachian tube they may be the cause of deafness, which is not of rare occurrence among those affected with syphilis.

Ulcerations upon the walls of the pharynx, during the secondary period, are of much more rare occurrence than upon the structures of the palate. On the other hand, ulcers, originating in the disintegration of gummata of the submucous connective tissue, are frequently seen in the tertiary period, and indeed may be the only symptom of it. It is rare that gummata are seen in the stage of tumor-development, since patients usually do not seek the aid of the physician until they are annoyed by pain or difficulty in swallowing, and then ulceration has already begun, in the form of a sharply defined loss of substance of the mucous membrane, with a yellow suppurating base and intensely red edges. The destruction to which ulcers of this character give rise is often very extensive, and is followed by scars whose contractions give rise to displacement of the parts as well as to occlusion and constriction of passages. Through the contraction of the cicatrices, the orifice of the œsophagus may be constricted, or, if the ulcer was situated just at its orifice, complete adhesion may result, closing it entirely.

Gummata which thrust forward the posterior wall of the pharynx may originate in the periosteum of the vertebræ, and therefore, when tumors of the posterior pharyngeal wall occur in adults, we should always think of syphilis; while in children, retropharyngeal abscesses are more apt to be due to tubercular disease of the spine. Gummata of the vertebral column may, as shown in a case reported by Maisonneuve, and quoted by Lancereaux,[1] attain large size and be confounded with sarcomatous or cancerous tumors. Through their degeneration necrosis of the vertebræ may result, which may extend into and expose the vertebral canal.

Syphilitic affections of the mouth and pharynx, with the exception of solitary papules or condylomatous growths on the soft palate, cause, as a rule, great annoyance to the patient. This is especially true of some forms of fissures, of small recurring papules on the tongue, and of ulcerations belonging to the secondary period; while tertiary ulcers in the posterior part of the mouth and pharynx often occasion but little trouble. When lesions occur in the posterior nares, the patient complains of sensations of pain at the base of the skull, which radiate from thence towards the ears.

Extensive affections of the mouth are usually accompanied by a hypersecretion of saliva, due to reflex irritation, and this is also true of lesions of the palate and pharynx, where the excessive secretion renders deglutition difficult. Ulcerative processes belonging to the secondary period are characterized by the fetid odor imparted to the breath, which is quite different from that of mercurial or any other form of stomatitis.

With regard to syphilitic disease of the ŒSOPHAGUS, a number of instances have been recorded of cicatricial strictures occurring in syphilitic subjects; but, in a part of these instances, there is some doubt as to the syphilitic nature of the affection. Virchow[1] reports that he has met with one case, where he saw yellow gummy spots undergoing fatty degeneration, from which ulceration proceeded. Still more doubtful is the syphilitic nature of the ulceration or chronic thickening in the mucous membrane of the *stomach*, which has been attributed to this disease.[2]

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[1] L. c., p. 245.

Solitary ulcerations in the SMALL INTESTINE, which sometimes occur in syphilitic patients, can with much more probability be referred to syphilis, for the reason that similar ulcers from other causes hardly ever occur, and if of typhoid or tuberculous character, other symptoms would be present to render the diagnosis certain. All these affections, however, are of more interest in an anatomical than in a clinical point of view, for the symptoms which they cause are not especially noticeable, and even such cases as that reported by Schwimmer, where an infant with an obstinate intestinal catarrh, which resisted all the ordinary medication, but was cured with the yellow iodide of mercury, only admit the diagnosis of intestinal syphilis with a certain degree of probability.

In a case which was examined by Meschede numerous ulcers, with a black pigmented base, were found in the ileum ; at some points were fibrous cicatrices, and on the peritoneal surface of the intestine, small fibrous tubercles. Oser found infiltration of Peyer's patches with central ulceration and a thickening of the lymphatic vessels in the adjacent peritoneum. Wagner[3] noticed, in the lower part of the ileum, a round spot, about which the mucous membrane was thickened and sharply defined from the surrounding surface, while the central portion showed numerous little holes. The mucous and submucous coats formed a grayish-yellow, soft, homogeneous mass, and sent numerous prolongations into the muscular coat, which was in a condition of simple hypertrophy. The serous coat was irregularly clouded. With the microscope, it was seen that the affected place was infiltrated with cells. In Eberth's case (a new-born child with pemphigus) numerous spots of thickening (gummous deposits) were found in the intestinal walls, and the mucous membrane covering them was swollen and ulcerated.

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[1] Geschw., p. 415.

[2] *Wagner*, l. c., B. IV. p. 225, Case XVI. *Lancereaux*, l. c., p. 248.

[3] Arch. d. Heilk., IV. p. 370.

Förster met with a characteristic fibrous alteration of the glands of Peyer, in a child who died of hereditary syphilis. All of Peyer's patches had lost their villi, they were hardened and of a grayish-red hue, having a prominence at the centre, while most of them were covered with a little slough in the middle. A microscopic examination showed that they consisted of a dense network of connective tissue, which extended to the muscular coat, and toward the centre had degenerated into a finely granular detritus. On the upper surface was found, also, an abundance of cells and nuclei. Roth found a similar induration in the intestine of a child five days old, but it was not confined to the glands of Peyer, and there were scattered ulcerations, with sloughs, in both the small and large intestine.

Of much greater clinical importance are the syphilitic affections of the LARGE INTESTINE, and especially those of the *rectum.* The ulcerative process in the large intestine, which is attended with dysenteric symptoms, is mostly a terminal affection, which stands only in an indirect relation to syphilis, and is sometimes dependent upon uræmia or amyloid degeneration of the arteries of the mucous membrane. Clapton[1] has seen attacks of obstinate diarrhœa cease after the internal use of the iodide of potassium, and from this infers that they were due to syphilis, and Cullerier attained the same results in dysenteric attacks or obstinate diarrhœa, from rectal injections of the iodide of potassium, and drew the same inference as to the nature of the affection.

The RECTUM, and more especially the lower part of it, is quite commonly the seat of syphilitic ulceration, which may either be the primary sore or belong to the secondary or tertiary period. These ulcers gradually lead to *stricture of the rectum.* From the pretty copious literature of this subject we will merely refer to the points that strictures of the rectum occur much more frequently in women than in men, and that when they are not due to cancerous disease, they most commonly occur in women between the ages of seventeen and thirty years. The greater frequency of this affection in the female sex would imply that the anatomical relations have much to do with its causation; in other words, that the secretions from the genitals flowing over the anus may give rise to the ulcers in the rectum. Gosselin and Erskine Mason,[1] to whom we are indebted for a recent discussion of the whole subject, regard stricture of the rectum as a consequence, not of syphilitic affections, but of chancres. Mason observed fifteen cases in which there were no symptoms of constitutional syphilis; in two cases, the formation of the stricture preceded the appearance of secondary symptoms. But while a number of authors look upon chancre as the sole cause of the stricture, others, among whom are A. Guérin and Verneuil, urge the syphilitic nature of the process upon which the disease depends. Virchow, looking at the question from an anatomical standpoint, leaves it undecided, since he has had no opportunity to examine the early stages of the process. It must, however, be admitted that secondary ulcerations of the rectum may extend upward from affections about the anus, and also that gummata may occur in the rectum. Gummata, and the strictures resulting from them, will be distinguished from the affections of more frequent occurrence, which are due to chancre, on account of the greater distance from the anus at which they may occur; chancres being usually within four or five cm. from the anal orifice. Moreover, strictures which are due to gummata will be more apt to occur late in life, and may therefore be easily confounded with cancer. If stricture of the rectum is found in young women, it is probably due to chancre-cicatrices; if it is met with in old women and men, the inference should be that it is either caused by cancer or by a syphilitic infiltration, with its consequences. Only in those cases in which no cicatricial tissue has been formed, that is, where the contraction is due to the infiltration alone, will the results of an antisyphilitic treatment contribute anything toward rendering the diagnosis more certain.

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[1] St. Thomas's Hospital Reports (London), New Ser., Vol. III., 1872.

In regard to the SALIVARY GLANDS and the PANCREAS, which, as appendages of the digestive tract, may be mentioned here, it can only be said that it is extremely rare for them to undergo any characteristic alterations. With the exception of a case that was under the care of Rostan, and mentioned by Lancereaux, in which, in addition to gummata in the muscles, two were also found in the pancreas, no changes in these organs are reported, except in their parenchyma (submaxillary gland, Lancereaux)—fatty degeneration of the pancreas in infantile syphilis (Virchow), or an increase in the consistence of the glands.

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[1] Amer. Journal of Med. Sciences, Jan., 1873. p. 22.

The PERITONEUM is not uncommonly involved when it covers the liver, spleen, ovaries, or other organs which have become diseased in consequence of syphilis; and in such cases it is usually the seat of an adhesive inflammation, giving rise to adhesions of the above organs with the diaphragm, the omentum, or with a fold of the intestine. Sometimes these adhesions may be very extensive, so that, as in a case reported by Lancereaux, the peritoneal cavity may be obliterated. Universal adhesive peritonitis is, however, more frequent in syphilis of infants than in that of adults.

That ascites may result as a consequence of interference with the portal circulation, from pathological changes in the liver due to syphilis, has already been stated.

RESPIRATORY ORGANS.

Nasal Cavities: *M. Kohn* (*Kaposi*), l. c.—Larynx and Bronchial Tubes: *L. Türck*, in *Zeissl*, l. c., p. 205 and Klinik d. Krankh. d. Kehlk. u. d. Luftröhre. Wien, 1866, p. 377.—*Gerhardt* u. *Roth*, Virchow's Archiv, B. XX., 1860, p. 402; XXI. p. 7.—*E. Wagner*, l. c., B. IV. p. 221.—*Virchow*, Geschw., B. II. p. 413.—*Gerhardt*, Deutsches Archiv f. klin. Med., B. II., 1867, p. 537; III. p. 292. (On syphilitic disease of the air-passages.)—*Morell Mackenzie*, Transact. Path. Soc., Vol. XXII., 1871, p. 33.—*A. Thierfelder*, Path. Histologie d. Luftwege u. Lunge, 1 Lief., Leipzig, 1872, Taf. II., Fig. 1 u. 2.—Lungs: *P. Yvaren*, l. c., p. 307 (Phthisic syphil.).—*S. Wilks*, Trans. Path. Soc., Vol. IX., 1857, '58, p. 55.—*E. Wagner*, l. c., p, 356.—*Virchow*, Archiv, B. XV. p. 310; Geschw., B. II. p. 463.—*Förster*, Würzb. med. Zeitschr., B. IV., 1863, p. 3.—*Wilson Fox*, Syph. Affect. of the Lung. Reynolds' Syst. of Medic., Vol. III., 1871, p. 792.—*A. Thierfelder*, l. c., Taf. V., Fig. 3.

Nasal Cavities.—The nasal mucous membrane, during the eruptive period of syphilis, is affected by a catarrh of greater or less intensity, but which is usually subacute in character, and is not marked by any special symptom except its long duration. This affection plays a very important rôle when it occurs in young children. The secretion is then more plentiful, causing a snuffling noise in breathing, and interferes greatly with the act of drinking, since inhalation through the closed nasal passages is rendered extremely difficult. On account of the constant wetting to which the alæ of the nose and the upper lip are exposed, excoriations and papules in these situations are of frequent occurrence. When the nasal catarrh is very severe, and particularly in young children, it is highly probable that there are mucous patches on the nasal mucous membrane. In these cases the secretion becomes purulent. Under the conditions which favor the occurrence of ulcerative processes on other mucous membranes, erosions, or even deep ulcers, also occur upon the mucous membrane of the nose, which readily involve the periosteum and perichondrium, and lead to necrosis. But such processes are rare in the secondary period of the disease. They usually first appear in conjunction with gummata of the skin or bones, and in a portion of the cases they are also due to similar deposits in the nose. The appearance of these destructive processes in the nasal cavity is marked by a purulent discharge, which is often mixed with blood, and possesses an intensely offensive odor, which is exhaled with the expired air, rendering the patient an object of aversion to any one near him (ozæna syphilitica). The secretion remaining on the ulcerated parts of the mucous membrane, or on such portions of bone as are denuded, becomes dry by the passage of air through the nose, and forms thick, brownish-yellow scabs, which are not easily removed. These crusts are sometimes attached to fragments of necrosed bone. Finally, perforation of the bony or cartilaginous septum of the nose, or of the floor of the nasal cavity, takes place, or changes in the contour of the nose make their appearance. If there is destruction of the cartilaginous septum, the tip of the nose sinks in and becomes flattened, while if the vomer is destroyed, the ridge of the nose becomes sunken, causing the tip of the nose with the nasal opening, to turn upwards. The ravages caused by necrosis may involve the superior maxilla, the ethmoid bone, and the pterygoid plates of the sphenoid. Even a slight defect in the nasal septum gives the voice a nasal tone, and any other changes which interfere with the free passage of air have the same effect.

The lachrymal canal is frequently implicated by extension of the ulcerative process from the cavities of the nose. This gives rise to symptoms of dacryocystitis, and usually to necrosis of the lachrymal bone.

When the mucous membrane of the superior portions of the nasal cavities is affected, the terminal filaments of the olfactory nerve are often involved, and the sense of smell is impaired or destroyed. This is sometimes seen as a result of the catarrhal, or, more probably, papular affections of the mucous membrane in the secondary period of the disease. Loss of the sense of smell may result also from other causes originating in syphilis, but which cannot usually be diagnosticated. In regard to this point nothing certain is known, except that after an antisyphilitic treatment the sense of smell may return after having been for some time in a state of abeyance. I myself have seen one case, in which, after the perception of odors had been lost for two years, it was regained after treatment with the iodide of potassium, which had been administered in consequence of other sympto which gave rise to a suspicion that syphilis was present.

Anosmia may also be due to a deformity, with displacement of the nasal openings, or with the destruction of the entire nose, by means of which the current of inspired air passes from before backward by too direct a course. There is a case, briefly described by Hutchinson,[1] in which, while an artificial nose was worn, the patient had the sense of smell, which, however, was lost when this appendage was removed. The explanation of this appears to be, that, by means of the artificial nose, the inspired air was forced in such a direction as to pass up to the distributions of the olfactory nerves.

The LARYNX is an organ which is frequently affected, both in the early and later stages of syphilis. The harsh voice of syphilitic patients, the *raucedo syphilitica*, is a symptom to which attention was long ago called, and the laryngoscope has furnished us with a knowledge of the anatomical changes to which it is due. The form of laryngitis which corresponds to the syphilitic nasal catarrh, and to the ordinary form of angina syphilitica, has no special characteristics, and is, like ordinary laryngitis, a rather rare affection. It is more common to meet with a chronic catarrhal process which has become fixed in the inter-arytenoid space, and which leads to thickening of the mucous membrane. In this early period it is possible, especially at the posterior commissure, to find erosions or ulcerations, which begin in the mucous glands. But these have nothing about them which is pathognomonic of syphilis, and their nature can be determined only from other concomitant symptoms. Flat condylomata of the laryngeal mucous membranes are more characteristic, and these may be situated on the epiglottis, at the entrance of the larynx, or even upon the vocal cords. The condylomata, as well as simple chronic growths of the mucous membrane, may either vanish completely after the administration of anti-syphilitic remedies, or they may leave behind them changes in the membrane leading to permanent alteration of the voice.

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[1] Lancet, 1874, Vol. I. p. 233.

In the later stages of syphilis the laryngeal mucous membrane may be the seat of ulcers, which cause rapid destruction of tissue, and are surrounded by an intensely red and swollen edge, similar in every respect, in fact, to the tertiary ulcerations of the pharynx which were described above. The ulcer may be situated on the epiglottis, on one of the false cords, in the posterior commissure of the vocal cords, or upon one or the other of the cords themselves, though it is more apt to occur on parts above the cords. Although the ulcers are usually attended by deep and extensive swelling of the mucous membrane, they are not easily confounded with ulcerations of the larynx of tuberculous origin. The œdema attendant upon syphilitic ulceration is more limited; but still, under certain circumstances, it may produce such a high degree of stenosis as to cause suffocation. The influence of antisyphilitic treatment upon such ulcerations is very striking. Even in cases which present a very unpromising appearance, the administration of the iodide of potassium soon produces a marked diminution of the swelling, and causes speedy cicatrization of the sore. This may, of course, be attended by the formation of cicatrices, with various effects, depending upon their location.

These ulcers also frequently involve the *cartilages* which make up the larynx. Necrosis of the cartilages results from an extension of the process to the perichondrium, and may give rise to abscesses which break externally, with the formation of fistulæ.

If these ulcerative processes have been very extensive, or if they have recurred many times, the shape of the larynx may be so altered as to be scarcely recognizable with the laryngoscope. The epiglottis may be entirely wanting, or its place may be marked only by a small, irregular projection, and the cavity of the larynx may be converted into a cicatricial cone, with an opening not larger than a quill ; or sometimes the passage may be reduced to a mere fissure, on account of a partial adhesion of the vocal cords. According to the degree of the destruction will the disturbance of different functions vary, as of phonation, respiration, or deglutition. In regard to the performance of the last-named function, it may be observed that total loss of the epiglottis does not lead to any difficulty in swallowing nor to any choking sensation.

The same processes, which have been described as occurring in the larynx, are met with also in the TRACHEA and BRONCHI. Those which are of the most serious import in these localities are the ulcerative processes of the character just described. According to Gerhardt, the entire mucous membrane of the trachea may be the seat of ulceration ; but it is much more usual to see the lowest portion, just above the bifurcation, alone affected. In the beginning, the symptoms are those occasioned by tumefaction of the mucous membrane, moderate stenosis, a tickling sensation, pain back of the sternum, inclination to cough, and coarse, moist râles ; later, the symptoms are those of a constantly increasing stenosis, which can sometimes be seen by the laryngoscope, but which, according to Gerhardt, may be diagnosticated from stenosis of the larynx by the fact that during the convulsive inspiratory efforts there is but a slight motion of the larynx downwards.

The ulceration may lead to other complications, to perforation into neighboring organs, for example, into the aorta[1] or into the pulmonary artery.[2]

Syphilitic diseases of the LUNGS were described by most of the physicians of the last century as a peculiar form of phthisis (phthisis a lue venerea), but no anatomical lesions which were characteristic of this form of lung disease were discovered, and Morgagni asserted that syphilis merely predisposed to the development of ordinary phthisis. It is only in the last few decades that the fact has been established, chiefly from the examination of the lungs of new-born syphilitic infants, that in syphilitic disease of the lungs changes take place which are similar to those seen in the liver and other internal organs.

From a purely clinical standpoint this much might be urged in favor of the supposition (as held in former times) of a syphilitic phthisis, namely, that in a certain number of cases of well-marked pulmonary phthisis the administration of anti-syphilitic remedies was followed by a rapid recovery. A number of cases of this character have been collected by Yvaren. It is possible that in some of these cases there was really no affection of the lungs at all, though one was simulated by the high degree of anæmia and a laryngeal affection, with a cough and hoarseness, caused by the syphilis. The liability to commit such a mistake is greatly increased in those cases where a hectic fever is also present, as it often is in syphilis. A case which I reported[3] is an illustration of this; here all the general appearances of phthisis were presented, while the physical signs of pulmonary disease were wanting. The discovery of a node aroused a suspicion that the patient was suffering from syphilis, and the administration of the iodide of potassium was followed in a few days by the disappearance of the hectic fever and an amelioration of the general symptoms. This case was one in which the infection had taken place long previously; but syphilis during the eruption stage, and especially in young women, is sometimes attended by symptoms which give the impression that pulmonary phthisis is developing.

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[1] *S. Wilks*, Trans. Path. Soc., Vol. XVI., 1865, p. 52.

[2] *C. Kelly*, Ibid., Vol. XXIII., 1872, p. 45.

[3] Deutsches Archiv f. klin. Med., B. IX., 1872, p. 419, Case V.

On the other hand, in the advanced stages of the disease, in addition to other symptoms of syphilis, signs of pulmonary infiltration may develop, and if hereditary predisposition can be excluded, and there have been no special causes for the occurrence of destructive processes in the lungs, then there would seem to be some direct connection between the pulmonary disease and the syphilis. I have described a case of this kind in my paper,[1] cited above; but since there were no pathological changes characteristic of syphilis found, there is some doubt as to its syphilitic nature, although the favorable effect of the iodide of potassium upon the thoracic symptoms, as well as upon the fever, was very marked.

The patient was a woman, twenty-nine years old, of small stature, but well nourished, who, in addition to small ulcers upon the soft palate and the posterior wall of the pharynx, necrosis in the nasal cavities, and later serpiginous ulcers, which originated in a subcutaneous gumma and in ecthyma pustules, had symptoms of infiltration of the superior lobe of the left lung and diffuse bronchitis, together with an enlargement of the spleen and intermittent slight albuminuria. The remittent fever, which had lasted with no interruption for two months, disappeared for a few days, after administering the iodide of potassium, and the temperature rose when this remedy was suspended. Under the same treatment the symptoms of pulmonary trouble, with the exception of those due to the bronchitis, vanished.

Prof. von Ziemssen recently communicated to me a case in his own practice in which a deposit at the apex of the lung, accompanied by hectic fever, in a patient with syphilis, yielded to mercurial treatment.

It is desirable in every case of this character to be able to decide whether the pulmonary symptoms are directly due to syphilis or are only a chance complication. The results of an anti-syphilitic treatment in cases of long standing may not always permit a diagnosis to be made, for it is possible that the symptoms may be due to cicatrices which cannot be removed.

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[1] L. c., p. 423, Case VI.

The influence of anti-syphilitic treatment upon the course of the fever in these cases is of much importance in forming an opinion; for if the fever is solely due to syphilitic changes, it will yield in a few days to mercury, and especially to the iodide of potassium.

Syphilis can indirectly cause destructive bronchopneumonic processes in the lungs, either through the injury to the constitution, or more especially, by means of obstinate laryngeal affections attended with ulcerations, secretions from which enter the lungs by aspiration.

The pathological changes which are found in the lungs of syphilitic patients, and which may be looked upon as direct evidence of the disease, are of various forms. In the lungs of new-born children, with hereditary syphilis, a very characteristic change is found, in the form of a diffuse infiltration of the alveolar septa, which was described by Virchow[1] and F. Weber,[2] as "white hepatization during uterine life," but was first shown to be of syphilitic origin by Hecker.[3] Later, others, and more especially Wagner, have described cases of this kind, and Moxon[4] has shown that it is probable that the same change occurs in adults. The lungs thus affected are large, very heavy, and of a whitish color, the alveolar septa being much thickened by a cellular infiltration, with abundant fat granules, so that the alveoli, in some parts, are quite obliterated, while at others they are much diminished in size. Wagner[5] rarely found any organized elements in those alveoli which were of normal or of reduced size; but Virchow,[6] on the other hand, found them crammed with epithelium and the cells were sometimes filled with fat. Lorain and Robin,[7] and also Förster, make the same statement in regard to the affection, which is called by the first "epithelioma of the lungs," and by Förster "epithelial induration;" but it probably is not identical with the affection described by Wagner. In the lungs which Wagner examined, the smaller blood-vessels and capillaries were no longer visible, and the interlobular connective tissue was, for the most part, entirely free. This affection involves either a portion or the whole of the lungs. In some situations in the bronchial tubes, especially in their finer ramifications, he found the same infiltration of cells in the mucous membrane as existed in the lung tissue. The bronchial glands, too, showed cellular infiltration, and, in one case, in the form of deposits with yellowish centres.

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[1] Archiv, B. I., 1847, p. 146.

[2] Beitr. zur path. Anat. d. Neugeborenen. Kiel, 1852, 2 Lief., p. 47.

[3] Verh. d. Berliner geburtshilfl. Gesellschaft, VIII., 1854, p. 130.

[4] Guy's Hospital Rep., 3d Ser., Vol. XIII., 1867.

[5] L. c., p. 359.

[6] L. c., p. 469.

[7] Gaz. méd. de Paris, 1855, 12. Cit. in Förster, l. c., p. 4.

Either in connection with, or without these diffuse syphilitic infiltrations, there are found, scattered through the lungs of new-born infants, nodular infiltrations—gummy tubercles—which are mostly without capsules, and vary from the size of a hazel-nut to that of a walnut. These were described by Depaul,[1] in 1837, and have been figured by Lebert and Lancereaux.

According to Förster, syphilis may also manifest itself in the lungs of infants, in the form of unusually dense deposits, which when cut with a knife, present a smooth lardaceous surface; but these are always accompanied by an abundance of spindle-shaped and oval cells in the thickened interstitial tissue.

Gummy tubercles have, moreover, been repeatedly demonstrated *in adults;* but when the tubercles have undergone cheesy degeneration, it is exceedingly difficult to decide whether they are due to a syphilitic process, to tuberculous disease, or to catarrhal pneumonia. Even with the aid of the microscope this discrimination is rendered difficult, from the fact that, in tuberculous and chronic pneumonic processes, the alveolar tissue may also be infiltrated with cells.

There is a more or less diffuse form of *chronic interstitial pneumonia*, which leads to the formation of fibrous cicatrices in the lungs, which has been referred, by several authorities, to a syphilitic origin. Of this kind are the cases described by Vidal,[2] Dittrich,[3] and Moxon;[4] and Wagner alludes to the possibility of the cicatrices being due to the absorption of syphilomata in the lungs, in the same way as in the liver and spleen. But very similar changes may occur independently of syphilis—particularly in consequence of the inhalation of irritating dust.

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[1] *Lancereaux*, l. c., p. 429.

[2] Ibidem, p. 329.

[3] Prager Vierteljahrschr., 1850, II. p. 42.

[4] Trans. Path. Soc., Vol. XXII., 1871, p. 38.

Virchow[1] mentions, finally, a peculiar condition which he has found several times in adult females, which resembles the brown induration of the lungs that occurs in connection with valvular lesions of the heart. In these cases, without there being any obvious impediment to the circulation, a large amount of pigment was found in the lungs—especially accumulated in the alveolar epithelium, which was unusually luxuriant.

CIRCULATORY SYSTEM.

Heart: *Ricord*, Gaz. des hôp., 1845, 101. Clin. iconograph., pl. 29.—*Lebert*, Traité d'anat. path., T. I., p. 470, 570, pl. 68.—*Virchow*, Archiv, XV. p. 282. Geschwülste, B. II., p. 441.—*Haldane*, Edinb. Med. Journal, Vol. VIII., 1862, p. 435.—*S. Wilks*, Guy's Hosp. Rep. III. Ser. Vol. 9, 1863.—*E. Wagner*, Archiv d. Heilk., B. VII., 1866, p. 524.—*M. Morgan*, Dublin Quart. Journ., Vol. 52. 1872, p. 42.—*J. Hutchinson*, Lond. Hosp. Rep., Vol. III., 1866, p. 382.—Blood-vessels: *Dittrich*, Prager Vierteljahrsehr., 1849, I. p. 21.—*N. Friedrich*, Herzkrankheiten, 2 Aufl., 167, p. 194, Note. (Gummous Myocarditis, fibrous Pericarditis, Pleuritis und Mediastinitis).—*Müller*, Die Syph. d. Circul.-Organe. Inaug.-Diss. Berlin, 1868.—*C. O. Weber*, Verh. d., niederrh. Gesellsch., 1863, p. 171 (Exstr. in *Wagner*, l. c., p. 530).—*W. Moxon*, Lancet, 1869, II.—*Heubner*, Archiv d. Heilk., B. XI., 1870, p. 272. Tagblatt der Naturforscherversamml. zu Leipzig, 1872, p. 167.

The action of syphilis upon the HEART is manifested, sometimes, in the form of *gummy tumors*, and, sometimes, in the form of an *indurated myocarditis*. These changes are either found by chance at the autopsy, or the mode of death may have pointed to some cardiac trouble, though, during life, not diagnosticated nor recognized as due to syphilis. The symptoms are the same as those met with in the usual form of myocarditis, or such as pertain to any disturbance in the function of the muscular tissue of the heart. Therefore, when a syphilitic patient has suffered for a long time from pretty severe palpitation, irregularity of the heart's action, and symptoms of derangement of the circulation, we can merely surmise that the symptoms are possibly due to a cardiac affection of syphilitic origin, and the probability of this being the case would be strengthened, were there no history of antecedent rheumatic disease. But since rheumatoid affections are of such common occurrence in the course of syphilis, the history of the case will not assist us much—the cases of syphilis which present these symptoms being usually of long standing. The *gummata* of the heart are, anatomically, very characteristic. They are found in varying numbers in all parts of the muscular tissue, varying in size from a pea to a pigeon's egg, and if they are situated near the endo- or pericardium these membranes are thickened, and often as hard as cartilage. If the gumma is cut open, it is found to consist of a pretty homogeneous mass, of a yellowish-white or brownish-yellow color, sometimes dry and sometimes moist, movable, and enclosed in a capsule which is composed of fibrous, or softer and vascular connective tissue (Virchow). These tumors are composed largely of small cells, resembling in their structure many sarcomata, from which they are distinguished, according to Virchow, by a tendency to the formation of large cheesy spots, with amorphous basement substance. Large phthisis tubercles may also bear a very close resemblance to them; but the presence or absence of general tuberculosis must be relied upon to determine the diagnosis.

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[1] L. c., p. 470.

Bundles of fatty muscular fibres are found both at the periphery and in the interior of the muscle of the heart. Fibrous indurations generally occur in the cardiac tissue at the same time, or they may be the sole changes present. If fatty or cheesy masses are found in the indurations, the question may arise as to whether the changes are not due to a gummy tumor in process of resorption, and it might be even possible that all the indurations were the remains of such tumors. At all events, these cicatricial indurations may be looked upon as a metamorphosis of an interstitial growth of cells, but at present it is unknown whether this cellular growth is diffuse from the very beginning, or whether the cells are, from the first, massed together in the form of a tumor. In addition to these cicatricial and fatty changes, Lancereaux mentions a waxy or amyloid degeneration, which he met with in two cases.

The changes which the heart, as a whole, undergoes in consequence of these affections are, principally: enlargement from dilatation of its cavities, and a more or less extensive fatty degeneration; but, whether gummata may soften and discharge into the cavity of the heart, has never been certainly ascertained, though a case reported by Oppolzer appears to render it probable that this may take place. But embolic processes may occur in other ways, since gummy tumors in the walls of the heart, which project into one of its cavities, when associated with a partial dilatation, consequent upon cicatricial degeneration of the cardiac walls, may lead to spontaneous coagulation of the blood at the points where the tumors are situated.

On the *pericardium*, in addition to cicatricial induration over gummy tumors, or in connection with cicatrices due to myocarditis, *miliary granules* may be found, which the microscope shows to be composed of indifferent cells, and may be therefore regarded, like the well-marked gummy tumors, as products of syphilis (Wagner).

Changes in the larger BLOOD-VESSELS, which may with certainty be attributed to syphilis, have thus far been observed very seldom. C. O. Weber described a case of stenosis of a branch of the pulmonary artery, caused by a soft, gelatinous nodule, of the size of a bean, growing from the middle coat of the artery, and associated with a diffuse thickening of the media. Wagner also found, in one case, changes in the pulmonary artery, in the form of smooth tubercles, which, upon section, were found to be grayish red in color and soft. Virchow[1] saw, in one case, a small, hard, bluish tubercle, which was close above the valves of the pulmonary artery, and at the post-mortem examination of a girl nineteen years of age, a growth of small warts was found upon the semilunar valves and the adjacent portions of the pulmonary artery. Atheroma of the arteries has, however, in many respects, so much similarity to the new growths due to syphilis, that (especially in such cases as the one described by Virchow,[2] in which, in early youth, atheromatous changes of a high grade were found, with well-marked evidences of syphilis) it seems to be allowable to suppose a connection between these changes and that disease. It has been attempted, at various times, by Morgagni, Wilks, and others, to establish a connection between the formation of aneurism of the aorta, or of other arteries, and syphilis; and this seems to be quite proper, in so far as this disease is the cause of atheromatous or other degeneration of the arterial walls.

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[1] Archiv XV., p. 253.

[2] Geschw., p. 444.

Contractions of the carotid arteries, occasioning considerable disturbances in the cerebral circulation, have been observed repeatedly, and if more attention were paid to this point in case of other such symptoms, it is probable that it would be found that similar alterations take place in other vessels. Lancereaux, in connection with a case observed by him, calls attention to the circumstance that the change which had taken place was not of the character of atheroma, but there was a circumscribed thickening which was due to a deposit of cells and nuclei. Similar thickenings have recently been noticed (Heubner), in the adventitia of the smaller vessels of the brain; they occurred very abundantly in the brain, in a case reported by C. Allbutt,[1] in which it was doubtful whether these infiltrations were seated in the walls of the vessels or in the perivascular spaces.

The blood-vessels in the course of this process either undergo a contraction of their calibre, which may lead to thrombosis, or if retrograde metamorphosis of the cell-growth sets in, the strength of the walls of the vessels becomes impaired, and small aneurisms are formed, which, in the case of the cerebral arteries, may, by their rupture, cause grave symptoms, or even lead to death.

Amyloid degeneration of the blood-vessels may also be mentioned, as a change which takes place, in some way as yet unknown, in consequence of syphilis. It is often first recognized in the vascular coats, and, as a rule, begins in the smaller vessels.

THE NERVOUS SYSTEM.

L. Gros et *E. Lancereaux*, Des affections nerveuses syphil. Paris, 1861.—*Virchow*, Archiv, B. XV. p. 290. Geschw., II. p. 444.—*S. Wilks*, l. c. —*E. Wagner*,

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[1] Transact. Path. Soc., Vol. XXIII., 1872, p. 16.

l. c., B. IV. p. 161.—For Symptomatology, see numerous articles by *Hughlings Jackson* in the Med. Times and Gazette, Lancet, London Hosp. Rep. since 1861.—*Owen Rees*, Guy's Hosp. Rep., Vol. XVII., 1872, p. 249.—*Broadbent*, Lancet, Jan. and Febr., 1874.

Since a special division of this work will be devoted to *syphilis of the nervous system*, we may here confine ourselves to a brief mention of the numerous forms under which the nervous system may be affected in syphilis.

In the first place, as already indicated, the affection of the various parts of the nervous system may be of a purely *passive* nature, as when protuberances form on the inner surface of the bony case which encloses the brain or spinal marrow, causing compression of these organs, or as when a nerve is subjected to pressure during its passage through a bony canal which is affected by the disease. According to the degree of injury done to the nerve tissue, will the result be either simply a disturbance of function, which disappears completely with the removal of the cause, or the nervous substance may sustain severe and permanent derangements of its nutrition, which will be all the greater in case it is itself implicated in the syphilitic changes. It is in a perfectly analogous way that those syphilitic affections act, which proceed, not from a bony envelope, but from membranous sheaths of the central nervous system, or from the surrounding connective tissue of the peripheral nerves, or, from adjacent organs.

A second category of affections which are peculiar to the central nervous system—particularly the brain—are dependent upon disturbances of nutrition in the nerve substance, caused by syphilitic disease of the *nutrient vessels*. (See above, p. 218.) A diminution of the calibre of the internal carotid, the middle cerebral, the basilar, and other arteries, in consequence of syphilitic disease, may give rise to grave lesions of the brain.

Finally, the *connective substance* of the central organ may become the seat of diffuse or circumscribed syphilitic disease (gummata), in consequence of which, the ganglion cells and nerve-fibres undergo secondary lesions. It is not yet decided whether the proliferation of cells which takes place has its starting-point on the neuroglia or in the connective tissue which surrounds the small blood-vessels.

Quite recently[1] changes have been discovered in the ganglia of the *sympathetic*, which are analogous to the changes in other organs: hypertrophy of the interstitial connective tissue induces atrophy of the nerve-fibres and ganglion cells, with marked pigmentation and colloid degeneration.

The *symptoms* which are directly or indirectly caused by the action of syphilis upon the nervous system are of the most various description. Among them may be mentioned: irritative manifestations, epileptic attacks, unilateral convulsions (which are said, by Hughlings Jackson, to be pathognomonic of syphilis), fixed pains and paralysis; furthermore, symptoms of slowly increasing pressure within the cranium, with sudden and total cessation of the function of important portions of the brain (apoplectic attacks)—aphasia, and psychical disturbances—may present the most varied pictures of disease, and it is often only by the concomitant symptoms, the history of the case, or sometimes by the result of antisyphilitic treatment, that a diagnosis is reached. It is especially common to meet with paralysis of the muscles of the eye as a consequence of syphilis, and those muscles are particularly liable to be affected which are supplied by the oculo-motorius; so that when they are found paralyzed it is always well to think of syphilis.

Diabetes or polyuria may also, though more rarely, be due to nerve trouble, originating in syphilis, as is made probable by the history of a case recently reported by Mosler.[2]

Syphilitic affections of the nervous system occur mostly during the tertiary period of the disease; but this rule is not without exceptions, since grave nervous symptoms may occur at quite an early period—in the stage of eruption, even; Fournier mentions the occurrence of facial paralysis as early as this. It is more frequent, however, to meet with purely functional disorders at this time, such as the insomnia that is so common, various forms of headache, neuralgic symptoms, and disturbances of sensation—especially analgesia, which occurs very frequently among women, and has recently been very fully described by Fournier.

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[1] *Petrow*, Virchow's Archiv, B. 57, 1873, p. 121.

[2] Virchow's Archiv, B. 58, 1873, p. 51.

ORGANS OF THE SPECIAL SENSES.

The Eye: *C. Schweigger*, Handb. d. spec. Augenheilk., 2 Aufl. Berlin, 1873.—*L. Mauthner* in *Zeissl*, l. c., p. 261 s.—*v. Graefe*, Deutsche Klinik, 1858, No. 21. —*J. Hutchinson*, A Clin. Memoir on certain Diseases of the Eye and Ear, etc. London, 1863.—*Liebreich*, Atlas der Ophthalmoskopie. Berlin, 1863.—*Pulcheria Jakowlewa*, Ueber Keratit. interst. diff. In.-Diss. Zürich, 1873.—Organ of Hearing: *J. Gruber*, Wien. med. Presse, 1870, Nos. 1, 3, 6, 10. Ref. im Archiv f. Derm. u. Syph., B. III. p. 82.

It has already been stated that the SENSE of SMELL may be destroyed, through ulcerative and necrotic processes in the nasal cavities. Syphilitic processes proceeding from the base of the skull or from the cerebral membranes may interfere with the functions of the olfactory nerve by compression or by extension of the morbid process to the nerve itself.

The affections of the EYE are more common and of more importance.

The *eyelids* participate in the various cutaneous affections of syphilis, and may even be the seat of the primary lesion under certain circumstances. Magawly[1] has several times met with a thickening of the palpebral cartilages,—a lesion which is probably due to syphilis.

In several cases—in one of hereditary syphilis—there were seen upon the *conjunctiva bulbi*, well-defined tumefactions, of a somewhat coppery color, which extended slightly over the edge of the cornea, and in one case (France[2]) were accompanied by a tubercular eruption on the face. Smee, who was the first to report cases of this kind, states that the affection can be cured by anti-syphilitic treatment, and France confirms this statement. Similar tumefactions have been recently described by von Wecker,[3] Estlander,[4] and Hirschberg,[5] and by them are regarded as gummy tumors.

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[1] St. Petsb. med. Zeitschr, B. XII., 1867, p. 219.

[2] Guy's Hosp. Rep., III. Ser., Vol. VII., 1861 (plate).

[3] Traité theor. et prat. des mal. des Yeux, T. I., Ed. II. Paris, 1867, p. 177.

[4] Monatsblätter f. Augenheilk., B. VIII., 1870, p. 259.

[5] Cit. by *Mauthner*.

Of much more practical value is an affection of the *cornea*, which, as Hutchinson has shown, is almost exclusively found in cases of hereditary syphilis, and is known as *interstitial* or *parenchymatous keratitis*. This disease develops itself in patients with hereditary syphilis, usually at the time of the second dentition, and also in girls, at the time of puberty. It manifests itself gradually, with photophobia and subconjunctival injection, which may be either slight or very intense, and a diffuse opacity advances from the edges towards the centre, by means of which the cornea finally becomes of a uniform milk-white color ; within the diffuse opacity there may be spots of a still whiter appearance. Ulceration never occurs in the course of this process. Gradually the cornea begins to clear up, proceeding from the circumference towards the centre again ; though from five to seven months, or perhaps a year, may elapse, from the commencement of the affection, before the cornea becomes quite transparent again ; or cloudy or striped opacities, whose appearance is very characteristic, or possibly an altered curvature of the cornea may permanently remain. Now and then fluctuations occur in the course of the affection, and sometimes relapses.

When the duration of the process is prolonged, it is associated with iritis, in the form either of an *iritis serosa* or of an *adhesive iritis*, with implication of the ciliary body and choroid.

It is extremly rare to meet with this affection of the cornea in acquired syphilis (Jakowlewa). Both eyes are usually affected —not, however, at the same time, but in succession. The presence either of this disease of the cornea or of evidences of its previous existence, is sufficient to arouse at least a suspicion of hereditary syphilis, and for this reason the affection is of great importance in a diagnostic point of view.

Iritis belongs to the more frequent complications of the secondary period, and usually makes its appearance while the exanthem is still present. It occurs either in the usual adhesive form, with intense subconjunctival injection, great photophobia, sharp supraorbital pain, contraction or distortion of the pupil and punctate deposits—chiefly upon the inferior half of the posterior surface of the cornea ; or else in the form of a yellowish-red papule, from the size of a pin's head to that of a pea, which is usually situated at the margin of the pupil, and consists, as shown by Graefe and Colberg,[1] of a circumscribed proliferation of cells—in short, represents a small syphiloma. In conjunction with this, the usual symptoms of iritis, and often hypopion, are present. This form, which is more usually confined to one eye than the former variety, generally occurs at a somewhat later stage of syphilis, and is found in conjunction with very well-marked papular or ulcerated forms of the cutaneous eruption. When iritis occurs in the later stages of syphilis—several or even many years after the infection—it is not generally the first attack of the affection, but a recurrent one, to which the synechiæ left from the previous attack, which was, perhaps, attended by insignificant symptoms, render the iris peculiarly liable. An affection of the ciliary body and the choroid may accompany the iritis, or, in consequence of synechiæ or total occlusion of the pupil, secondary changes may occur, at a later period, in the deeper portions of the eye.

Iritis is of rare occurrence in hereditary syphilis; but, as Lawrence, Hutchinson, and others have shown, it may occur, coincidently with an exanthem, in either of the two forms described above.

The *choroid* may be affected independently of iritis, and the inflammation may be either acute or chronic; nevertheless, there is no anatomical form which may be said to occur exclusively in syphilis—that is, there is nothing which may be termed pathognomonic of the syphilitic choroiditis. Von Graefe has described, under the term *choroiditis disseminata*, a form of inflammation which frequently occurs in syphilis, and is marked by the occurrence of numerous, very small, white, roundish deposits of exudation, with red borders, which are scattered over the choroid, but are chiefly accumulated about the posterior pole of the bulb, though they occur also in the neighborhood of the equator, with the retinal vessels coursing over them, unchanged. These punctate deposits may either entirely disappear, or atrophic conditions may develop in the choroidal pigment, leaving small spots, devoid of pigment and surrounded by a black border, which remain permanently. The subconjunctival injection, which was alluded to above, is often present only in slight degree. Opacities in the vitreous humor occur here as in every choroiditis. The derangements of vision, to which these processes give rise, will vary in accordance with their seat, extent, and the duration of the changes.

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[1] Archiv f. Ophth., B. VIII. p. 288.

These different choroidal affections, like the iritis, belong to the secondary period of syphilis.

A growth of cells, which was supposed to be gummous in its character, was described by von Hippel[1] as having been found in the choroidal and sclerotic coats, as well as in the ciliary body, and, encroaching upon the retina, in a bulb which had become atrophied in consequence of irido-choroiditis.

The *retina* is also, sometimes, independently attacked in secondary syphilis; the patient complains of a gradual diminution of the power of vision, moderate photophobia, and various other subjective symptoms, and, upon examination with the ophthalmoscope, the fundus looks as though it were veiled, this appearance being due to an infiltration of the retina. The boundary of the papilla is indistinct, and the papilla itself is more or less reddened; the veins are often congested, and sometimes, also, there are hemorrhages. This affection usually attacks both eyes at the same time, and is quite chronic in its course; but if appropriate treatment is employed at an early stage, the vision may be perfectly restored.

Von Graefe[2] has described an affection of the retina, which is probably due to syphilis, under the name of "*central recurring retinitis*." In this affection slight exudations occur at the macula lutea, which rapidly disappear again, and this appearance and disappearance may be repeated several times.

A form of *retinitis pigmentosa* has recently been described which is attributed to hereditary syphilis (Swanzy, Galezowski, and other authors).[3] This affection, according to Hutchinson,[4] is

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[1] Archiv f. Opth., B. XII., 1867, p. 55.

[2] Archiv f. Ophth., B. XII., p. 211.

[3] Compare Jahresber. über d. Fortsch. im Gebiete der Ophthalm. von *A. Nagel*, B. II., 1873, pp. 295, 299.

[4] *R. Swanzy*, Dublin Quarterly Journal, Vol. LI., 1861, p. 294.

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characterized by its rapid development, the early occurrence of amaurosis, want of symmetry—both eyes not being affected—the roundish form and irregular arrangement of the pigment spots, which are generally situated in the intervals between the larger vessels, and by the implication of the choroid.

The retina may also be affected, secondarily, in affections of the optic nerve, which are due to syphilitic changes taking place in the osseous or membranous envelopes, or in the substance of the brain. Atrophy of the optic nerve and retina then takes place, giving rise to a progressive diminution of central vision, with defects at various points in the field of vision. It should also be stated here that in some cases the ophthalmoscopic appearances of engorged papilla may exist for a long time without any considerable impairment of vision (Hughlings Jackson).

The *optic nerve* has been found several times affected in a specific way in consequence of gummy growths in the neighborhood, encroaching upon its sheath, or involving the substance of the nerve (Dixon[1]). Horner[2] describes a case of neuritis with enormous thickening, in a man, aged forty-three years, who was suffering from various other syphilitic symptoms, and within three weeks became totally blind, and died with paralytic symptoms. The ophthalmoscope showed the papillæ to be of a cloudy white appearance, the veins distended and tortuous, together with a slight amount of extravasation at the border of the optic nerve. At the autopsy, in addition to the changes in the nerve, numerous encephalitic deposits were found, and the liver contained a quantity of partially degenerated syphilitic tubercles.

ORGAN OF HEARING.

In the account of the syphilitic affections of the pharynx it was observed that it was not uncommon for them to cause a temporary or permanent occlusion of the orifices of the Eustachian tubes. This is the starting-point for *catarrh of the tympanum*, and a frequent cause of deafness and tinnitus aurium, which are apt to occur in the course of syphilis. Such a catarrh of the middle ear may have the same issues as those due to other causes, and lead to perforation of the membrana tympani, purulent infiltration of the cells of the mastoid process, etc. These conditions are especially apt to occur in consequence of hereditary syphilis ; but Hutchinson has observed some cases of deafness in which the history did not point to the occurrence of catarrah of the middle ear, and, upon examination, the membrane and Eustachian tubes were found in a normal condition. In cases of this character, the disturbance, to which deafness is due, must be more deeply seated, either in the labyrinth or in the auditory nerve. More accurate investigation with regard to this subject is needed ; but Rayer[1] has observed a case of deafness on the right side which was due to a tumor of the size of a pigeon's egg, upon the upper side of the petrous portion of the temporal bone, which pressed upon the auditory nerve, and which was probably syphilitic in character.

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[1] Med. Times and Gaz., 23. X., 1858.

[2] Jahresber. v. *A. Nagel*, B. II. p. 315.

Deafness may be caused by syphilitic affections of the *external auditory meatus*, in which moist papules sometimes develop ; or syphilitic enlargements proceeding from the perichondrium of the cartilage of the ear may cause a greater or less obstruction of the canal. Hyperostoses, in consequence of syphilis, have also been observed, both in the osseous meatus and in the bony portions of the Eustachian tube.

THE URINARY ORGANS.

Rayer, Traité des malad. des reins. Paris, 1840, t. II.—*Virchow*, Archiv, B. XV. p. 314.—*Barde*, De syphil. renum affectionibus. Diss. inaug. Berlin, 1863.—*A. Beer*, Die Eingeweidesyphilis. Tübingen, 1867, p. 27 s., p. 71, p. 161 s.—*Gujol*, Essai sur l'albuminurie syph. Thèse de Paris, 1867.—*W. Moxon*, Guy's Hosp. Rep., Ser. III., Vol. 13, 1868, p. 329.

Until within the last ten years nothing was known of true syphilitic processes in the kidney. Their occurrence had been suspected, and it had also been ascertained that albuminuria was not a rare complication in the later stages of syphilis ; but the only pathological change which was known to occur, and which was sufficient to account for the phenomenon, was amyloid degeneration. But we have since learned that the kidneys are liable to the *diffuse infiltration* as well as to the development of *gummy tumors.* The gummata which were seen in the few cases described by Tüngel, Cornil, and Lancereaux were only about as large as peas. Beer met with tumors of the same kind, but still smaller in size, and to him we are indebted for our knowledge of the *diffuse interstitial proliferation of cells*, which is usually connected with amyloid changes of the vessels and fatty degeneration of the parenchyma of the kidney. This interstitial growth of cells leads to cicatricial contractions, and it is often in these that the miliary syphilitic tubercles are found.

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[1] Mentioned by *Gros* and *Lancereaux*, l. c., p. 381.

These changes, however, are not in themselves characteristic of syphilis; in case we have to do with gummy tumors, it is necessary to have recourse to concomitant symptoms in order to exclude tubercle, and if with diffuse infiltration, we must eliminate other conditions, such as variola and typhus, which might produce similar effects, before we are justified in pronouncing the changes syphilitic. Moreover, the discovery of unquestionably syphilitic affections in other organs—the liver, testicle, or bones—will assist in determining the diagnosis.

Albuminuria, either with or without dropsical swellings, occurs not infrequently in connection with affections of bones and joints. I had a case of this kind under observation for several years, and during that period, at various times, the urine was perfectly free from albumen.

A. H., a laborer's wife, aged twenty-eight years, who gave no history of hereditary or acquired syphilis, in May of 1867, came under my care at the German Hospital in London. She was pale and cachectic in appearance, with a large serpiginous ulcer upon the ear and temple, which had partially healed, swellings of the knee, elbow, and right shoulder joints, and œdema of both inferior extremities. In consequence of this condition of the legs she had for two years been deprived of their use. The urine was found upon examination to be heavily loaded with albumen. Under the use of the iodide of potassium the condition of the patient improved with extraordinary rapidity; not only did the swellings of the joints and the dropsy vanish, but the appearance of the patient became that of perfect health, and the menses, which had been absent for some months, reappeared. In January, 1868, although she was pregnant, there was but a trace of albumen in the urine. The child, which was born on the 30th of May, was perfectly healthy and normally developed, although the mother still had a small spot of ulceration upon the head, and suffered from an enlargement of the joints from time to time. On the 27th of July and on the 9th of August, and again on the 26th of October, the urine was free from albumen, and the woman appeared healthy. I lost sight of her from this date until July, 1869, when a marked enlargement on the right tibia, and swelling of the right elbow-joint led her to seek relief at the Hospital. The ulcer on the scalp was found to be entirely healed, but the urine was again very rich in albumen. Under the influence of the iodide of potassium the amount of albumen considerably diminished; but whether this influence was permanent or not, could not be ascertained, since, on account of the distance she was obliged to come, her attendance at the Hospital was very irregular. In the early part of the year 1871 she lay in the London Hospital, suffering from severe pain in the bones of the legs. When I last saw her, on the 21st of March, 1871, her appearance was very good, but the urine, which was light-colored, contained a large amount of albumen.

Prescott Hewett[1] relates the case of a man, with a depression of the skull, who suffered also from albuminuria, but was cured by the iodide of iron, and Beer[2] reports a similar result following the use of the iodide of potassium. Mr. Bradley[3] reports a case of hereditary syphilis in a child, four months old, who had a papulo-squamous syphilitic eruption and universal dropsy, together with albumen and a quantity of cylindrical epithelium in the urine; in this case a cure was effected, both of the eruption and of the renal disease, in the course of about three weeks, by the use of hydrarg. c. creta. Bradley expressly states that in this case there was no possibility of there having been any infection from scarlatina. In addition to this, the same observer states that out of twenty cases of hereditary syphilis in which he examined the urine, in two of them he found albumen.

No affection which can be attributed to syphilis has as yet been observed in the *pelvis* of the kidney, the *ureters*, or the *bladder*. Ulcerations in the urethra are associated with certain processes which take place upon the genitals, and they pertain much oftener to chancre than to syphilis.

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[1] Presid. Address, Trans. Clin. Soc., Vol. VI., 1873.

[2] L. c., p. 56.

[3] Brit. Med. Jour., 1871, Vol. I. p. 117.

THE GENITAL ORGANS.

Testicles: *Astruc*, l. c., p. 192.—*Benj. Bell*, Treatise on gonorrhœa virul. and lues vener. Edinburgh, 1793, Vol. I. p. 285; Vol. II., p. 103.—*Astley Cooper*, Dis. of the Testis. London, 1835.—*Ricord*, Clin. iconogr.—*J. Hamilton*, Essay on Syph. Sarcocele. Dublin, 1849.—*Vidal* (de Cassis), Du sarcoc. syph., Mém. de la Soc. de Chirurg., 1851 et 56.—*Virchow*, Archiv, B. XV. p. 263; Geschw., B. II. p. 431.—*De Méric*, Fungus of the Testicle in Syph. Lancet, 1859, March 19.—*J. F. West*, Dublin Quart. Journ., 1859, Nov., p. 323.—*Lewin*, Stud. über d. Hoden, Deutsche Klinik, 1861, No. 31.—*S. Wilks*, Trans. Path. Soc., Vol. VIII., 1858, p. 240; Vol. X., 1860, p. 210; Vol. XII., 1861, p. 216. Guy's Hosp. Rep., l. c., p. 55.—*E. Canton*, Trans. Path. Soc., Vol. XIII., 1862, p. 161.—*S. Wilks*, Ibid., Vol. XVI., 1865, p. 189. (Enlargement of both Testicles in a five months' old Child suffering from Congenital Syphilis).—*Huber*, Deutsches Archiv f. klin. Med., B. VI., 1869, p. 104. (Anat. Unters. v. *Zenker*.)—Ovaries: *Richet*, Traité d'anat. chirurg. Paris, 1857, p. 573. (*Lancereaux*, l. c., p. 229.)—*Lecorché*, Gaz. méd. de Paris, p. 743. (*Lancereaux*, ibid.)—Mammary Glands: *Yvaren*, l. c., p. 435.—*Virchow*, Geschw., B. II. p. 436.—*Hennig*, Archiv f. Gynaekol., B. II., 1871, p. 350.—*Lancereaux*, l. c., p. 156.

THE TESTICLES.—Owing to the confusion which existed until the latter part of the last century, concerning the relation between syphilis and urethral blennorrhœa, all swellings of the testicle of venereal origin were formerly classed together. Astruc, indeed, divided them into two classes, placing in one those forms of inflammation of the testicle which were acute and were associated with gonorrhœa, and in the other those which were of a more subacute character and were not associated with gonorrhœa; but Bell first made the distinction perfectly clear and positive.

In the blennorrhaic affection it is the epididymis that is affected, the trouble being due to an extension of the inflammation along the spermatic duct and into the tubules of the epididymis, accompanied by an exudation into the tunica vaginalis; while the testis remains intact. When, however, the affection is of a syphilitic nature (sarcocele syphil.), the testis becomes the seat of the disease, which may make its appearance either as a simple indurated interstitial growth, or in the form of tubercular caseous deposits (gummy tumors). As in other organs which are covered by serous membranes, the tunica vaginalis becomes involved in the process (vaginalitis), giving rise to adhesions or complete occlusion of the sac.

The cell-growth upon which these affections depend commences in the fibrous capsule and in the septa of the testis, beginning usually at the periphery, and advancing into the rete testis. Dense, bluish-white bands of fibrous connective tissue gradually develop, and between them the seminal tubules become atrophied. According to the location and extent of the process, either a uniform contraction of the testicle will be left, or irregular constrictions, with various alterations in the form, may remain.

In the other variety, yellowish-white, dry tubercles, varying from the size of a millet seed to that of a cherry, are found in the midst of fibrous tissue—either infiltrated through it, or the tissues form a sort of capsule about them. In the later stages this yellowish-white substance, as in the similar tubercles in other organs, consists of an amorphous or fine felt-like mass, containing minute fat granules or the more or less recognizable remnants of disintegrated cells. Towards the periphery of the tubercle large fat globules occur, and still further outward we meet with fibrous or still vascular connective tissue, which contains numerous cells embedded in it. Virchow (whose description we follow mainly) found in one case also crystals of cholestearin within the cheesy tubercle.

There is no positive evidence as yet that gummy tubercles may soften, gradually penetrate the tunica vaginalis, and then, like subcutaneous gummata, break externally. It is well known that perforations followed by ulceration do take place, but the mode in which they occur may differ from the above. As in a case described by Huber, the ulcerative process may begin upon the skin, having been excited there in consequence of pressure or friction of the parts; the ulceration extending into the testicle, the latter becomes prolapsed, and a granulating fungus growth is formed.

Syphilitic sarcocele occurs at a late stage of acquired syphilis; it is very rarely seen as a symptom of inherited disease. It is apt to be associated with gummous affections of the bones, and tubercular or ulcerative diseases of the skin. In none of the cases of this affection reported by Zeissl did it make its appearance in less than ten months after the first syphilitic symptoms, and, as a rule, many years had intervened. Frequently it is impossible to determine just when the trouble in the testicle begins, since the progress of the affection is slow, commencing with very slight symptoms, and the patient only becomes aware of it after a considerable swelling has taken place. It occasions very little pain, the tumor is but slightly sensitive on pressure, and, in this respect, it differs very essentially from the blennorrhagic epididymitis, which is generally exceedingly painful. The swelling and hardness of a syphilitic testicle may be very marked, but if the appropriate treatment is promptly resorted to, they recede pretty rapidly. But inasmuch as the condition has usually existed for a considerable time before medical aid is sought, the result of treatment is not always so rapid, and in case the stage of cicatricial contraction has already been reached, the effect of remedies is often only partial. When left to itself, the course of the affection is very protracted; a pretty marked swelling remains stationary for a long time, or gradually gives place to contraction and deformity.

Usually but one testicle is affected, and if the second becomes involved, it is not until the disease has been present for some time in the other; sometimes, however, both are attacked together at the same time. When both glands are thus affected, the functional derangements are of a serious nature, since complete aspermia and permanent impotence may be the result; while if but one testicle is involved, the procreative function remains intact. According to Lewin, in cases of partial fibrous orchitis, there is sometimes an absence of spermatozoids in the testicles.

Blennorrhagic epididymitis can scarcely be confounded with syphilitic sarcocele; at least so long as it is in the acute stage. Doubt may more readily arise when a blennorrhagic affection has left behind it an induration; but when this is the case, the head of the epididymis is the part implicated, while the syphilitic induration affects the testis. Affections of the testicle of a tuberculous nature, also, as a rule, originate in the epididymis, the process, according to Virchow,[1] starting from the walls of the vas deferens. These are further distinguished from syphilitic affections, by the gradual softening, suppuration, and formation of fistulæ. Gummata of the testicle have often a great resemblance anatomically to tuberculous deposits, but the latter are more friable and can be more readily separated from the neighboring tissues, and moreover, in tuberculosis of the testicle miliary, gray, and yellow tubercles are met with. Cancerous or sarcomatous growths in the tissues of the testicle are distinguished from processes of syphilitic origin by their rapid growth, the irregular alterations in form which they occasion, by their painfulness, and by the fact that cancer never attacks both testicles. Cancerous disease gradually causes ulceration, giving rise, then, to the condition known as fungus testis malignus.

With the exception of a case of gummous growth in the *vas deferens*, described by Verneuil,[2] syphilitic affections of the other portions of the internal male genital apparatus have never been observed. With regard to the *external genitals*, we should mention a partial induration of the *corpora cavernosa*, a condition which has been described by Zeissl.[3] It is probably due to a process of the same nature as the diffuse syphilitic orchitis, and leads to changes in the form of the organ which are particularly noticeable when it is in a state of erection.

But few changes have been noticed in the FEMALE genitals which can with certainty be referred to syphilis, excepting the primary and secondary affections of the vulva and neck of the uterus. Inasmuch as fibrous degeneration of the ovaries, especially in advanced life, is so commonly met with, cicatricial changes in these organs can only be regarded as the result of syphilis when there are other circumstances present which point to the disease—as, for instance, in youthful persons, who bear decided evidences of syphilis elsewhere. Such changes have been described by Richet, and a case of gummous ovaritis, which is perfectly analogous to the similar affection of the testicle, is figured by Lancereaux.

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[1] Geschwülste, B. II. p. 682 s.

[2] Cit. by *Lancereaux*, l. c., p. 228.

[3] L. c., p. 248.

A few instances of imperfect sexual development which have been noted (Hutchinson, Lancereaux)[1] render it extremely probable that ovaritis, resulting in atrophy of the organ, may occur in early youth in consequence of congenital syphilis.

Gummy tumors have been found in the *Fallopian tubes* by Bouchard and Lepine,[2] but whether they occur also in the uterus or not, has never been ascertained. Gummata, having all the characteristics of the gummy tumors in the submucous connective tissue, are not infrequently met with upon the *external genitals.* Sometimes, when they ulcerate, they become very similar in appearance to soft chancres or phagedenic primary syphilitic sores; but confusion will usually be avoided through the presence of other symptoms of tertiary syphilis in the skin or bones, or the scars of such as have previously existed.

The *functional* disturbances of the sexual system, which are met with in syphilis in women, are partly dependent upon the anæmia caused by the disease; but they may also be, in part, due to certain unrecognized changes in the structure of the mucous membrane, or substance of the uterus, or to disease of the ovaries. Irregularities in the menstrual function, of all grades—from complete amenorrhœa to profuse metrorrhagia—together with fluor albus, may occur in consequence of these various conditions; but frequently syphilis runs its course with no disturbance of menstruation. The capacity for conception may be impaired on account of certain conditions arising in the course of the disease, but in the majority of cases it remains unchanged. Pregnancy, however, is frequently not continued to its normal term; *abortion and premature delivery are among the most common effects of syphilis.* But their causes are not always to be sought in the maternal organism; the abortion may be due to a diseased fœtus, which owes its disease to a syphilitic father. (See above, p. 53.)

Gummy tumors have been demonstrated in the MAMMARY GLANDS beyond a doubt. Verneuil has described a tumor of this kind in the breast of a man, and Hennig found them in the female breast. In addition to these, there are numerous reports of cases in which tumors of the mammary gland have been absorbed in consequence of anti-syphilitic treatment. (Yvaren, Maisonneuve, Richet, Lancereaux.) The last-named observer alludes also to a diffuse swelling of this gland which he observed in connection with Ambrosoli, and which disappeared under treatment with iodine. Moreover, Hennig[1] states that changes in the mammary glands sometimes take place in children with hereditary syphilis.

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[1] L. c., p. 330.

[2] Gaz. méd. de Paris, 1866, p. 756 (*Lancereaux*).

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[1] Tagbl. d. Naturforscherversamml. zu Leipzig, 1872, p. 201.

HEREDITARY SYPHILIS.

When syphilis is transmitted from parent to offspring, whether from a syphilitic father, or from a syphilitic mother during gestation, the disease manifests itself in various ways. The fœtus may either become diseased at an early stage of its development, in consequence of which it dies and abortion takes place; or it may be born alive prematurely; or be still-born at full term; or, finally, the pregnancy may go on normally to full term, and the child at birth appear perfectly healthy, but some time afterwards give evidences of its constitutional taint. In many cases—especially in such as belong under the first three categories—the *placenta* is found diseased, and we proceed next to speak of the syphilitic affections of the placenta.

Syphilis of the Placenta.

S. Wilks (Observation made by *Wilkinson King*), Guy's Hosp., Rep. l. c.—*Virchow*, Geschw., B. II. p. 477.—*Kronik Slavjansky*, Prag. Vierteljahrschr., B. 109, 1871, p. 130.—*Ercolani*, Delle malattie della Placenta. Bologna, 1871.—*C. Hennig*, Jahrb. f. Kinderheilk., B. I., p. 424. Stud. über d. Bau d. menschl. Plac. und ihr Erkranken. Leipzig, 1872, p. 33.—*E. Fränkel*, Die Placentar-Syphilis. Archiv f. Gynaekol., B. V., 1873, p. 1 s.

Although a few of the changes found upon the placentæ of syphilitic children had already before been ascribed to syphilis, Virchow was the first who investigated this question minutely; and he first pointed out the necessity of keeping the fœtal and maternal membranes separate and distinct, in looking for any alterations which might be due to syphilis. Virchow thought it an open question whether the fœtal portion was primarily affected or not; but in one case he found, on the maternal portion of the placenta, a hard, wedge-shaped gummous tubercle.

He described also another form of disease which he met with in the decidua of a syphilitic mother, and that consisted of a thickening and polypoid growth of the free—not the placental—portion of this membrane; but this, as is proved by a case reported by Strassmann, is not necessarily due to syphilis. E. Fränkel, by taking the osteochondritis described by Wegner (see page 170) as the criterion of hereditary syphilis, recently demonstrated that the fœtal portion of the placenta is often affected by a growth of cells which fills out the villi, and frequently leads to atrophy of their vessels through compression. This process, which Fränkel terms "*deforming granulation-cell hypertrophy of the placental villi*," may also encroach upon the neighboring portions of the maternal placenta.

A placenta which has undergone this change is larger, heavier, and more dense than normal, and is either uniformly or at certain portions of a pale color, and the tissue which remains sound is congested with blood or beset with extravasations. The amnion and chorion are also more or less clouded and thickened, and in many cases numerous miliary deposits have been found along the vessels, upon the fœtal side of the placenta; these owe their origin to a growth of the connective tissue of the chorion.

Fränkel thinks that this form of the affection is the most frequent, and that it is due to syphilitic infection from the side of the father. In this form it is possible for the mother also to have been infected in the act of coitus. There are only seven cases known of primary affection of the maternal portions of the placenta (endometritis placent. gummosa). In cases of this kind we must either presuppose that syphilis existed in the mother at the time of conception, or that her infection was coincident with that of the ovum, or occurred very shortly afterward. In cases belonging to either of the two latter classes, changes may be found both upon the maternal and fœtal portions of the placenta. Gummous disease of the placenta makes its appearance under the form of yellowish-white tubercles, which must not be confounded with the decolorized blood coagula which sometimes occur in otherwise normal placentæ. In Virchow's case, the periphery of the tubercles was more dense and whiter than elsewhere, and in some places was studded with caseous spots, while the centre was more reddish and softened. The tubercles consisted of connective tissue with large cells, and at certain points there were large accumulations of younger cells. Hennig was the first who called attention to the intimate relation of the cell growth to the vessels. The obliteration or compression of numerous vessels of the villi interferes with the mutual interchange of gases between the maternal and fœtal blood, causing fatty degeneration of the villi, and, if the process is extensive, the death of the fœtus (Fränkel). But the fœtus may also become syphilitic when no changes are discernible in the placenta.

Syphilis of the Fœtus.

The degree of syphilitic disease in the fœtus varies with the intensity of the syphilis which existed in one or both of the parents at the time of conception. But the circumstances bearing upon this question are of such a complicated nature that no definite rules have yet been established. Only this much can be positively affirmed, namely, that the product of conception generally dies at an early period when one or both parents have suffered from recent syphilis at the time of conception ; and *the more recent the general syphilis in the parents at the time of conception, the greater will the liability be to abortion.* Hence, while the first pregnancies under these circumstances are generally interrupted prematurely, the later ones—especially when a mercurial course has been resorted to—become longer and longer in their duration, and finally, after a series of abortions or premature births, children may be carried to full term, and be born in a state of real or apparent health.

When the fœtus dies in utero it is usually born in a state of maceration, the epidermis being wanting over large surfaces of the body or elevated in bullæ, and the amniotic fluids are often cloudy, of a greenish or brownish color, and have an offensive odor. If the fœtus has been carried almost or quite to its full term, we find, either on the surface of the body or in the internal organs only, and invariably in the epiphyses of the long bones, the changes which were detailed above. Von Bärensprung supposed that if the syphilis of the fœtus was inherited from the father, lesions would be found in the liver and suprarenal capsules, but if from the mother, in the lungs ; but further evidence does not confirm the existence of any such extraordinary relation as this.

Children that are *born alive* are usually small, undeveloped, and have an aged appearance ; the skin is either already covered with a rash, or in a few days papules or pemphigus bullæ make their appearance. Tubercles resembling boils (see p. 166), develop in the subcutaneous connective tissue, and may break upon the outer surface. The children soon become affected with marasmus, and perish in a short time from diarrhœa, or from suppurations connected with the epiphyseal affection.

The eruption, which is almost universally known as pemphigus neonatorum syph. (but which Zeissl, on account of the slight resemblance of its bullæ to the transparent ones of true pemphigus, prefers to call varicella syph. confluens), may also be found upon infants at their birth. It consists of flabby bullæ, from the size of a pea to that of a hazel-nut, several of which may become confluent, and which contain a thin, greenish pus. A favorite seat of this eruption is on the palms of the hands and soles of the feet ; in the latter situation, especially, the epidermis is apt to be rubbed off, laying bare the intensely red papillæ beneath ; but there is no loss of substance. The entire body, but particularly the face, is often found covered with the bullæ, which, on drying, form crusts, which spread at their edges.

A very similar eruption (pemphigus cachecticus) is sometimes met with in children who are not syphilitic, but are suffering from marasmus ; and this has induced some authorities to deny—though incorrectly—the existence of a syphilitic pemphigus. Zeissl urges, as a mark of distinction between the two forms, the rapidity with which the bullæ of the non-syphilitic affection become dry. Lancereaux rests the diagnosis of syphilitic pemphigus upon the fact that it appears within a few days after birth, and is located especially on the palms of the hands and the soles of the feet ; while, if the eruption is of the non-specific variety, the bullæ are distributed more generally over the body. But if the case is at all doubtful, the antecedents of the child must be carefully inquired into before a diagnosis can be reached.

Some of the children born with hereditary syphilis are at birth well nourished and strong, and for some weeks go on in their normal development. But gradually the infant becomes delicate ; frequently, the first symptom which attracts notice is a nasal catarrh, and coincident with this, or soon after, a cutaneous eruption appears. This eruption may be macular, or, as is more usual, papular in character, and may be limited to a few bright red papules upon the buttocks, which rapidly assume the characteristics of mucous patches. Sometimes the entire body, but especially the face, is covered with large, flat papules, which have the perfect copper color, and here and there are coalescent. At the angles of the mouth and eyes, in the neck, behind the ears, and in the inguinal folds they take the form of moist papules and increase rapidly in size.

The discharge from the nasal passages, which become more and more obstructed, acquires a more purulent character, and causes excoriation of the nostrils and upper lip. In the mouth, evidences of stomatitis—swelling of the gums—appear, and mucous patches occur in the throat. If the symptoms are very intense the children fail rapidly and soon die. Where the manifestations are of a milder nature, the eruption becomes gradually less pronounced in color, and a few condylomata only remain at their most usual seats—the anus, genitals, and angles of the mouth. But the nutrition of the child remains impaired; the skin assumes a pale, earthy color, and the physiognomy acquires a peculiar character, which, as the child develops, becomes more and more pronounced. Among the most striking of its features are a depression or flattening of the nasal ridge and a certain degree of hydrocephalus, with marked prominence of the frontal protuberances. The changes in the brain which lead to hydrocephalus, as well as some other processes (the encephalitis, for example, which was anatomically demonstrated by Virchow [1]), do not always run their course without giving rise to symptoms. The children are often very restless, crying a great deal, especially at night, are backward in their intellectual development, and when grown often present striking idiosyncrasies of character.

Iritis is met with in children with inherited disease, although not with the same frequency as among patients with acquired syphilis. It is of more frequent occurrence among girls than among boys; it attacks sometimes but one, sometimes both eyes, and is most common in the fifth month of infant life (Hutchinson). *Deafness*, due to changes in the middle or internal ear, may also be present at this time.

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[1] Archiv, B. 44, 1866, p. 472.

Rheumatoid symptoms occur now and then, even in infants, and usually depend upon the epiphyseal affections already spoken of. I have seen painful symptoms develop in the vicinity of different joints, in a child of eight months. No objective symptoms could be found in any of the bones and joints, but the child kept the affected limbs motionless, and gave evidence of intense suffering when passive motion was made.

The period at which the *first outbreak* of symptoms occurs, in those children with hereditary syphilis *who are born apparently healthy*, is very uncertain ; the latest period being stated by different authors at from one week to several months. It most frequently occurs from the fifth to the eighth week after birth. Von Rosen[1] found that out of sixty-eight cases occurring in the Lying-in Hospital, in Copenhagen, only nine showed the symptoms of the disease later than three months after birth. More extensive statistics show that nearly one-half of the children are attacked within the first month of life ; one-third in the second ; about one-eighth in the third, and only one-eleventh at a later period. The symptoms very seldom begin in the first week, and not frequently in the second.

If the symptoms appear at an early period, the children usually die ; but if long delayed they are sometimes very light in character, and even when they are well marked may disappear spontaneously. Many children with inherited syphilis have only a few moist papules about the anus or genitals, which may relapse many times during the first year of life, though the children still preserve a healthy appearance and may be fat and strong.

Children with hereditary syphilis who have passed through the acute stage, with or without treatment, may develop normally or remain pale and weak, and they may bear traces of the disease for life. Moreover, they may ever after remain free from all symptoms of a specific nature. It is very common, however, to have a new train of symptoms developed at the time of the second dentition, or—and this is especially true of girls—at the time of puberty. Among these may be mentioned keratitis interstitialis (see page 222), eruptions resembling rupia, serpiginous ulcerations of the skin, or, lastly, affections of the osseous system, which, unlike those of the tertiary period, are frequently symmetrical in their development. At this time, too, it is common to meet with ulcerative processes in the throat or upon the hard palate, with necrosis of the bone. Changes in the liver or kidneys, which have been hitherto in progress, may now first manifest themselves in appreciable symptoms (ascites, hydrops). In addition to all these manifestations, the children show disturbances of the nervous system at this period, which may be attributed to syphilis—such as epilepsy, chorea, and paralysis (Hughlings Jackson).[1] The paralyses of the cranial nerves, which are so common in adults with acquired syphilis, are so extremely rare in cases of inherited disease that Hutchinson has never seen a single case. But H. Jackson reports one case of facial paralysis with paraplegia in a child with hereditary syphilis.

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[1] L. c., pp. 223 and 226.

Von Græfe (Arch. f. Ophth., B. I. p. 433) observed a case of paralysis of the oculomotorius in a child two years of age, who showed traces of former iritis, and had a papular eruption. At the post-mortem examination there were found circumscribed thickenings of the sheath of the left oculomotorius, and softened deposits in both hemispheres. There was, however, a reasonable doubt as to the hereditary character of the syphilis in this instance, which was strengthened by the presence of a copious papular eruption in the second year of life.

The group of symptoms just described is sometimes found at puberty in children who are perfectly well developed, and whose appearance, as well as their history, gives no ground for a suspicion of the existence of hereditary syphilis. It was such cases as these—which are certainly very rare—that gave rise to the supposition of "a tardy development of hereditary syphilis" (s. hereditaria tarda), while, according to some authors, the development of the disease may be still further delayed in women, and be determined by the state of pregnancy or the change of life. But cases of the latter class must be regarded as of such an extremely doubtful nature as to be here discarded. As for the rest of the cases of supposed tardy development, the symptoms really belong to the tertiary period (some of them possessing such peculiar characteristics as the interstitial keratitis), the secondary stage having been simply overlooked because very light; or since it occurred at a very early period of life, and was perhaps attended by no very noticeable manifestations upon the skin, those who had care of the child may have lost all recollection of it. In several of the cases which have been adduced as examples of delayed development of an inherited syphilis,[1] mention was made expressly of secondary symptoms having occurred at an early period, and in others the presence of deformities of the skull or of the incisor teeth gave positive evidence that the syphilis had manifested itself during the first few months of infancy. To suppose, in explanation of these cases, that the child may have passed through the acute stage of syphilis in utero, have been born in apparent health, and then afterwards have been attacked by tertiary symptoms, is assuming too much, since these children are usually still-born.

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[1] Cases of Diseases of the Nervous System in Patients the Subjects of Inherited Syph. Transact. of the St. Andrew's Med. Graduates' Association, Vol. I. London, 1868.

This brings us to the oft-repeated question, as to whether modified syphilis of the parents may not give rise to *other constitutional peculiarities* in the offspring than those imparted by a syphilis inherited directly. It has been supposed that such was the connection between *syphilis* and *lupus vulgaris*—a disease which undoubtedly has many points of resemblance to some syphilitic exanthemata. But all who have made a special study of this question agree that there is not the most remote relation between common lupus and syphilis. *Scrofula* has also been represented as a syphilitic inheritance, and the tertiary symptoms of hereditary syphilis have even been denominated as "*syphilitic scrofula.*" But a careful comparison shows clearly the great difference between true scrofulous symptoms, and the tertiary manifestations of inherited syphilis, and Hutchinson,[2] who has given special attention to this subject, asserts with great positiveness *that hereditary syphilis neither predisposes to consumption nor to the ordinary forms of scrofulous and tuberculous disease.*

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[1] Compare *v. Rosen*, l. c., p. 230.

[2] Med. Times and Gaz., 1867, Vol II. p. 658.

But hereditary syphilis, manifesting itself as it does at the most important period of the development of the individual, is followed, not only by the direct manifestations which are known as tertiary symptoms, but by another train of morbid conditions which must be regarded as the remains of former disturbances of nutrition or of development, which took place at the early period while the syphilitic poison was still operating upon the fœtal or infantile organism. Under this head belong a portion of the above-mentioned nervous symptoms—eccentricities of character, idiocy, a tendency to epilepsy or to mental derangements.

RETROSPECT.

Now that we have described both acquired and inherited syphilis, in all their different phases, as well as the manifestations of the disease, as they occur in the various organs of the body, it may be well to review, connectedly, the events which mark *the development of syphilis*, and which have hitherto been only incidentally touched upon and in a disjointed manner.

The first event in the infection—as we comprehend it—is the production of a local deposit, in which the virus gradually increases, and from which, as a focus, an infection, slowly advancing by way of the lymphatic vessels, principally, but also through the blood, involves, by degrees, all the fluids of the body.

In the *syphilis d'emblée*—the occurrence of which is still a matter of much doubt—the first affected lymphatic gland is to be looked upon as equivalent to the primary affection; if a fœtus is infected from the mother, then it is the whole maternal organism, or, sometimes, the diseased maternal portion of the placenta, which is to be so regarded; where the mother is infected from a syphilitic fœtus, procreated by a syphilitic father (*choc en retour*), the primary affection exists in the fœtal portion of the placenta or in the entire fœtus.

This view of the local nature of the primary affection is not the one most generally adopted; in fact, the appearance of the primary lesion has long been regarded as a local expression of the general blood infection, which was supposed to take place immediately, through the inoculation. According to von Bärensprung, who advocated this view more particularly, the induration is "not the precursor of lues, but a proof of its actual presence."[1] This supposition is based mainly upon the non-inoculability of the secretion of the induration upon the bearer of it, and upon the existence of a period of incubation. Von Bärensprung believed, moreover, that a correspondence was shown to exist between the substance constituting the induration and the products of the later stages of syphilis, in the action of iodine upon them, and thence inferred that the induration was a manifestation of the constitutional syphilis. Virchow has exposed the fallacy of this reasoning, and, as we have already seen, the proposition of Ricord, that the induration affords an immunity against the syphilitic poison—which was asserted so positively in his time—has since been essentially modified. Bidenkap succeeded, in a small number of cases, in inoculating the secretion of primary sores upon the bearers, and produced the same effects as though they had been healthy subjects. That these inoculations did not occasion merely local outbreaks, in an organism already imbued with syphilis, is evinced in the fact that the papules which resulted, developed one after another in exactly the order in which the inoculations had been made. At the points where the inoculations were made several days later, the papules also made their appearance later; in fact, they developed exactly as if the subjects of the experiments had not been syphilitic at all. (See page 97.) These cases, it is true, when compared with the large number of inoculations which were made by Ricord and his followers, only represent rare exceptions, but the query arises as to how many of the inoculations which were made from primary syphilitic lesions, before the incubation of syphilis was generally recognized, were kept under observation long enough to really ascertain the effects of the inoculations, since the specific action of the inoculated virus does not generally show itself until from three to four weeks have elapsed.

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[1] Mittheil. aus d. Abth. und Klin. für syph. Kranke. Berlin, 1855, p. 16.

Moreover, a number of therapeutic facts favor the theory that the primary lesion is at first a purely local affection. In numerous well-authenticated instances (Hüter, Humphry, von Sigmund, Vogt—see below) excision or cauterization of the primary lesion was successful in preventing the occurrence of constitutional symptoms, which could not have been the case were the syphilitic papule a manifestation of the general infection of the organism. It is true that Hunter, Delpech, and others long ago made similar experiments, which usually failed; for in these cases the edges of the wound became indurated and showed all the characteristics of the primary lesion. This does not appear so remarkable, however, when we consider that von Biesiadecki has shown us, by means of the microscope, that the cellular infiltration, which is the expression of the specific local irritation, extends along the blood-vessels to a considerable distance from the primary lesion (see page 110). What takes place here is exactly like what is seen in the extirpation of cancer. It is not necessary even that the cellular infiltration should be sufficient to amount to a papule. In the first twenty-four hours, the virus may so affect the tissues in the neighborhood of the point of infiltration that, in spite of the partial destruction by cauterization, an induration may develop in the remaining scar. Berkeley Hill[1] narrates a case in which he cauterized a wound upon the frænum with fuming nitric acid, within twelve hours after the coition; but notwithstanding this, the cicatrix became indurated and the patient had constitutional syphilis. Experiences of this kind only prove that the extent of the local action of the virus and its first effects cannot be accurately appreciated.

The next effects of the virus, which is constantly increasing at the point of infection, are manifested upon the neighboring *lymphatic vessels or glands*; and, either through the infection of successive groups of lymphatic glands, or through the absorption of the virus into the blood from the primary lesion and from the affected glands, or in both ways, the entire mass of the blood becomes gradually saturated with the poison, so that if the blood is then inoculated upon others syphilis will result. Exactly at what time this result becomes possible is not known, and Köbner[2] observes that, for the purpose of deciding this question, it would be desirable "to inoculate the blood of persons, who show no other indication of syphilis than a very recently developed papule, upon healthy subjects who submit themselves voluntarily to the experiment." That the entire mass of the blood becomes a vehicle of the virus, after the appearance of general symptoms, is evidenced independently of the direct proof furnished by inoculations, by the symmetry of the local symptoms and the universality with which the most different organs are involved.

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[1] L. c., p. 56.

[2] L. c., p. 67.

The inoculability of the secretion of certain of the local secondary symptoms shows that a still further increase of the poison takes place in them, and so long as this continues, a fresh supply of syphilitic poison is being constantly added to the blood. On the other hand, it is highly probable that an elimination of the virus is continually in progress. With the constantly changing relation between production and elimination of the virus we may have fluctuations in the patient's condition, as is often seen in the occurrence of fresh eruptions during the first weeks or months of the secondary period; especially when the course of the disease is interfered with by the action of the remedies employed. If there are only a few local deposits, the elimination of the virus may be so much in excess of its production that the organism is gradually freed from it. This takes place in a great majority of cases; at the expiration of eighteen months or two years the infection is entirely exhausted.

The cessation of symptoms may, however, be due to other causes. The tissues gradually attain a certain immunity against the virus which circulates through them; there are no longer any outwardly apparent effects of the poison, nor is there any possibility of a new infection having occurred from without. But there may still be enough of the virus in the blood to transmit the disease to others, if inoculated, or to induce symptoms again in the patient's organism when, for some reason yet obscure, he again becomes susceptible to the influence of the poison—as in the event of a temporary debility induced by unfavorable external influences.

The syphilis is now said to have become *latent*, and this condition has from early times attracted the attention of physicians, and has called forth many attempts at its explanation. Virchow thinks the *dyscrasia* of syphilis is only temporary, but that it may from time to time be renewed through the repeated occurrence of a general infection of the blood from certain depôts in the body where the virus has been deposited. Various internal organs—*especially the lymphatic glands*—may serve as such depôts, in which the virus remains latent until certain outward influences determine a renewed increase of the poison at these places, and symptoms of a general infection are then repeated. Astruc opposed this view—for the same idea was maintained by some of the older physicians[1]—on the ground that no foreign substance could remain unchanged in any portion of the body, as it would either be expelled or else employed for nutritive purposes. Astruc therefore held that there was a *permanent dyscrasia*, and that the blood, when once contaminated, infected the new nutrient material as rapidly as it was received from the chyle, and thus the virus was constantly being increased. As long as this continual new production of the virus did not exceed certain limits, the disease remained latent; but if through outward influences disturbances arise in the organism, the disease again manifests itself.

Much may be said in favor of both of these views. Against the objection of Astruc may be urged the fact that cheesy deposits often remain for years in the body, and then suddenly give rise to a new infection. On the other hand, the latency of syphilis may be explained, on the supposition of a permanent dyscrasia, as follows: After the first general infection, which causes a powerful reaction in all the tissues, since the poison is yet something entirely foreign to them, an immunity from, or a sort of inurement to, the accustomed irritation ensues, so that, while the virus is still present in the fluids of the body—though constantly diminishing in amount—the local and general processes of nutrition proceed in an apparently normal manner, so long as no outward disturbances interfere. The more thorough the original infection was, the more complete will be the general and local immunity from the syphilitic virus. On the other hand, if, at first, only a small amount of the poison entered the general circulation (either because the infection was light, or because, by means of an early mercurial course, the action of the virus was temporarily restrained), the immunity of the tissues will be less complete. Then if, in some local deposit, as, for instance, in a remaining isolated papule of the skin, the virus has had an opportunity to increase to any extent, or if, after the complete extinction of the first infection (which was perhaps only very light) a fresh inoculation has taken place, a new and more intense infection of the blood may ensue, which manifests itself in a recurrence of the cutaneous eruption, of the disease of the throat, etc. Latency, therefore, is an indication that the virus does not exist in the fluids of the body in sufficient concentration to excite the irritability of the tissues; an increase of the poison or changes in the tissues which augment their irritability may make the disease again manifest. An insufficient mercurial course will very frequently render syphilis latent for a time, postpone the appearance of the secondary symptoms, and give rise to delayed and scattered outbreaks.

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[1] *Astruc*, l. c., p. 101: " —— vel in glandularum quarumdam recessibus seponi ubi sint in tuto, sed unde data occasione possint quasi ex insidiis erumpere et vi atque impressione sanguinem ceterosque humores, imo vero partes solidas pessundare."

Those cases in which, after years of apparent health, the syphilitic virus again shows its effects, either upon its possessor or upon the offspring, are extremely difficult of explanation. When all local manifestations, from which new supplies of the virus could be conveyed to the blood, have for years been absent, it must be supposed that the fluids of the body have become entirely free from the poison, and in these cases no other theory seems tenable than the one advanced by Virchow, which supposes the existence of concealed, perhaps circumscribed, deposits, in some of the internal organs.

As to the symptoms of the tertiary period of syphilis, we have already stated (p. 38) that we do not regard these changes as due to the direct influence of the syphilitic poison upon the tissues, and we will here only repeat that their peculiarity does not consist so much in the proliferation of cells as in the peculiar changes which the cells undergo in the course which they pursue,—changes which depend upon the modified constitution imparted to the tissues by the antecedent syphilis. This view does not conflict with the fact that, in fœtal syphilis,—and, therefore, at an apparently very early stage of the disease,—changes are found which belong to the tertiary period; for since the tissues of the fœtus are actually formed while under the influence of the virus, the processes to which this influence gives rise, may, to some extent, take the course which characterizes the affections of the tertiary period.

According to this view, a pronounced tertiary stage would imply a previous severe secondary period, and, in many cases, this is found to be true. But, on the other hand, cases occur in which the secondary symptoms have been light, and have even passed by unnoticed, and, notwithstanding, the tertiary symptoms have been severe. With regard to this apparent contradiction, it is to be remembered that the effect of a feeble operation of the syphilitic poison, continued for a long time, may be equivalent to one which is more intense, but of short duration. Moreover, in the production of the characteristic condition of the tissues, other elements besides the syphilitic virus—such as the character of the constitution, outward influences, and medical treatment during the time that the syphilitic intoxication is active in the blood—are of great influence. We see sometimes, even in the acute period of syphilis, outbreaks which approach those of the tertiary stage of the disease (impetigo, ecthyma, and rupia eruptions, destructive ulcerations in the throat, bone-affections). In hereditary syphilis this galloping form of the disease is exceedingly common.

Among the unfavorable external influences which, in conjunction with syphilis, predispose patients to the development of tertiary symptoms, it has been customary for more than three centuries to give the first place to mercury; indeed, some observers have gone so far as to designate tertiary symptoms as mercurial symptoms. That an injudicious use of mercury may have an injurious effect upon the constitution, and in combination with syphilis may favor the outbreak of tertiary symptoms is very probable, but that mercury alone can produce them is a supposition utterly untenable. Virchow, Kussmaul and Overbeck have confuted this hypothesis very completely.

It will be appropriate to consider at this place the influence which certain *physiological* and *pathological conditions* of the organism may have upon syphilis. The state of *pregnancy* exercises an unfavorable influence upon the course of syphilis, for, on the one hand, the constitutional symptoms of the disease are more pronounced, while on the other, the local manifestations —especially such as are situated upon the genitals—are apt to be of a particularly bad character; mucous patches, especially, under the influence of the venous congestion which exists commonly in pregnancy, often become enormously developed. After pregnancy has ceased, all the symptoms often disappear with surprising rapidity. As regards pathological conditions, it must first be observed that it is not as yet known what relations of mutual exclusion exist between syphilis and other diseases. Frequent observation has shown that various acute diseases have a marked effect upon the development of commencing syphilis, and especially upon the appearance of certain symptoms. Bassereau and Lancereaux [1] observed that, when acute febrile affections occurred in the course of syphilis, the disease was delayed, —perhaps the appearance of the exanthem was deferred. Several times also a disappearance of syphilitic exanthems was observed during the course of cholera (Lancereaux). The occurrence of erysipelas has a striking influence on syphilitic eruptions. In a case which was observed by Bidenkap (see page 98, Case III.) syphilitic papules, produced by artificial inoculation, became level with the surface during an attack of wandering erysipelas, and after the intercurrent affection had disappeared they became elevated as before. C. Mauriac [2] has recently supplemented a number of observations concerning this influence of erysipelas, which he collected from older writings [3] with a case in which moist papules of the lips and of the mucous membrane of the mouth and isthmus faucium disappeared during an attack of erysipelas. This effect is the result of the more active tissue changes in the indolent syphilitic cellular infiltrations of the skin or mucous membrane, these changes being due to the increased fluxion excited by the erysipelas; and in consequence of this the cells imbedded in the tissues either degenerate more quickly and are absorbed, or they are once more set in motion. This supposition is sustained by an observation of Cazenave[1] who saw a papulous eruption disappear with rapidity in the neighborhood of two spots where phlegmonous inflammation was developing.

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[1] L. c., p. 447.

[2] Gaz. des Hôp., 1873, No. 39, s. Arch. f. Derm. u. Syph., B. V., 1873, p. 596.—Id., Étude clin. sur l'infl. de l'érysipèle dans la Syph. Paris, 1873. (Gaz. hebdom., 1874, No. 7, p. 108.)

[3] Ibid.

Chronic diseases and certain constitutional conditions, among which may be mentioned chronic alcoholism and gout, frequently render the course of syphilis severe. Scurvy, which in hospitals is sometimes met with among syphilitic patients, is due more to their unfavorable hygienic surroundings and often, too, to the effect of remedies employed, particularly mercury, than to syphilis.

It is an interesting and important question, but one that has been as yet but little studied, as to what influence *latent or manifest syphilis may have upon other morbid processes.* Its unfavorable influence upon pre-existing phthisis is notorious. The effect can best be studied upon external affections—injuries, skin diseases—because these are so accessible to investigation. In the literature of the subject we find isolated statements that *fractures* did not heal in syphilitic subjects until antisyphilitic treatment was resorted to (Swediaur); such a case has been lately described by Barnes,[2] of Liverpool. In some cases syphilitic ulcers have developed from *granulating wounds* or from *scars.*

I observed an instance of this kind in a young person who had received a blow upon the shin, causing a wound which healed under a simple dressing. In a few days it broke out afresh at its edges, and spread peripherally, forming several ulcers of a decidedly serpiginous character, which together embraced two-thirds of a circle. The patient at the same time began to suffer from severe pains, which were worse at night, and his hair began to fall out. It is probable that the infection of this patient took place nine or ten months previously, for eight months before the time of the injury there had been some suppuration around the nail of the forefinger of the left hand, and a well-marked indolent enlargement of the cubital and axillary glands of that side.

Such occurrences as these must, however, be rare; otherwise they would be frequently seen in a disease so common as syphilis. Zeissl[1] admits that specific symptoms may be produced in syphilitic subjects by means of pressure or a blow, but denies that the process of healing of wounds, unless they occur in places already affected with syphilitic infiltration, differs in any way from that seen in normal tissues. Thomann[2] also denies that syphilis has any influence upon the process of healing, but J. Merkel[3] has recently reported some cases of gunshot injuries, in which syphilitic ulcers developed themselves in the wounds, the patients being affected with recent syphilis.

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[1] L. c., p. 271.

[2] Lancet, 1873, Vol. II., No. 18.

Von Bamberger[4] and Stöhr[5] have described instances where the pustules of variola have turned into syphilitic ulcers. But in this connection the fact must be borne in mind, that a *syphilitic* eruption of papules and pustules may be ushered in with active febrile symptoms, and present great resemblance to variola.

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[1] Wiener med. Wochensch., 1865, p. 324.

[2] Ibid., 1865, No. 21.

[3] Aerztl. Intell.-Blatt., 1870, No. 49.

[4] Oesterr. Zeitschr. f. pract. Heilk., 1858, No. 4.

[5] Deutsches Archiv f. klin. Med., B. IV., 1868, p. 487.

DIAGNOSIS.

The diagnosis of syphilis is sometimes a matter of much difficulty, owing to the great diversity of symptoms which may be presented at different stages of the disease. Some stages of the affection, and some of the individual phenomena are, however, so characteristic that the diagnosis can either be made as soon as they are discovered, or rendered so probable that it is only necessary to seek some confirmatory proof to establish it. In this list of typical symptoms belong well-marked primary indurations on the genitals, some forms of papular eruptions, condylomata, symmetrical exudative ulcerations of the tonsils, gummy iritis, papules on the palms of the hands, serpiginous ulcers of the skin, and tertiary ulcerations in the throat. In addition to these almost characteristic symptoms, which belong exclusively to syphilis, there are also many others which occur as well in the course of other diseases, and which, when considered by themselves, do not warrant a diagnosis of syphilis. It is often the case that the patient brings symptoms of this kind alone, or indeed but one such symptom, to the notice of the physician. It then becomes necessary to make a diagnosis from such symptoms as are to be found on a close scrutiny, assisted by a careful examination of the history of the case, and to assign a proper significance to the symptoms present. It is not enough to recognize a given symptom as of syphilitic origin ; if possible its relation to the whole course of the disease must also be ascertained, and, as a general thing, it is only when the history and other points of the case lead us to suspect syphilis that a symptom of this kind can be accepted as specific. Symptoms of this kind often require, before we can recognize them as syphilitic, the presence of coexisting or the traces of pre-existing symptoms, or a critical examination into the patient's previous health, or even delay until the result of the treatment employed can be seen.

The history of many cases is entirely unsatisfactory. Even among patients whose condition calls for no particular precaution or reticence, the facts of their past medical history, which they are able or willing to give, are often quite insufficient. All such narratives must be subjected to most careful scrutiny, and if this is true in regard to the histories given of themselves by men, it is doubly so in the case of persons of the other sex. Particular inquiries should be made in regard to such symptoms as are usually met with at an early stage of syphilis, such as cutaneous eruptions, falling off of the hair, sore throat, pains of the bones, and iritis; as to the primary sore, it may be spoken of by men, but scarcely ever by women. The diagnosis of primary syphilis can then only be made when the initial lesion has become noticeable and has been the seat of an induration of a more or less distinct character. If, after a well-ascertained period of incubation, there is found only an erosion seated on a parchment-like induration, which can only be felt by making pressure with the fingers at its edges, and if confrontation shows the source whence the sore was contracted to be a syphilitic one, it is safe to make a diagnosis of syphilis; and this is rendered more certain if in due time indolent buboes appear. It is often very difficult, and sometimes impossible, to arrive at a diagnosis when there are multiple lesions on the genitals, and when nothing certain as to their duration can be established, or when an ulcer or a vesicle has formed within a few days after exposure to contagion. Such lesions cannot be readily confounded with those of *herpes progenitalis*, since in this affection a group of small vesicles, seated on a reddened base, is usually met with. In these cases the diagnosis of syphilis cannot be made with certainty until the occurrence of indolent buboes, or of an induration at the base of the ulceration, or perhaps not until the outbreak of secondary symptoms. In such cases the physician must express himself with much caution, and will seldom be able during the first five weeks to give a positive diagnosis. He must never forget that the primary sore may at an early stage present the appearance of a simple, harmless-looking erosion, especially in women.

Attention has already been drawn (page 117) to various conditions under which confusion might arise; but to distinguish the inflammatory thickening of a chancre from the ulcerating initial lesion of syphilis, is not so difficult as to make a diagnosis between a primary papule, either dry or moist, and a papule belonging to the secondary stage. In a case of this kind the existence of indolent buboes would, to a certain extent, render the question more easy of solution; but special attention must be paid to the period which has elapsed since infection probably took place. Even when this cannot be definitely ascertained in uncomplicated cases, the symptoms which are met with generally furnish data sufficient to lead to a correct opinion as to the chronology of the disease. If, in a sore which made its appearance some days after infection, there is found, after some time, an induration accompanied by indolent enlargement of the glands, it is safe to suppose that from four to five weeks have elapsed since infection took place. The same supposition is justifiable if a dry papule, followed by a similar enlargement of the lymphatic glands, is met with.

The commencement of the secondary stage is the period of the disease at which the fewest difficulties in diagnosis are met with. Obscurity may arise at this time from the occurrence of unusually active febrile symptoms, or of irregular forms of cutaneous eruptions. The most important points relative to the differential diagnosis have, however, already been given (pp. 127, 128, and 135).

The longer the time that has elapsed since the eruptive stage, the more difficult is the diagnosis, since we have then to deal with symptoms which are of a more isolated character. Among these, then, are some which are characteristic of syphilis and which have been given above; there are others, however, which ought to arouse a suspicion of this disease, and lead to a search for other manifestations of it. Among these are, paralyses of cerebral nerves, persistent neuralgias, headache, and pains in the bones, which are more intense at night, loss of hair, abortion, especially when it is of repeated occurrence, remittent febrile attacks, symptoms of a rheumatoid character, and finally, such as occur with equal frequency without the existence of syphilis, as anæmia, loss of flesh, general weakness, and nervous disturbances of the most varied character.

The diagnosis is often attended with special difficulty during the *tertiary* period, when the symptoms are isolated ones, and are due not to lesions of accessible parts of the body, but of internal organs. In such cases the chance discovery of an exostosis, of a characteristic scar, or the like, often serves to put the observer upon the proper track. If we learn from a patient that he has recently, or some time previously, suffered from syphilis, we should bear in mind that therein may lie the possible cause of any ordinary affection which he may present. In all cases in which there is any suspicion of syphilis, a careful examination must be made of all those parts of the body upon which the earlier manifestations of the disease are apt to be localized.

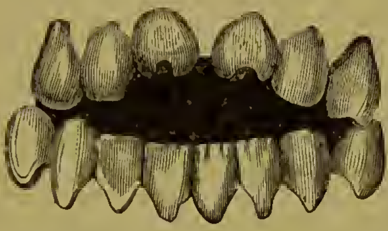
Above all, the inguinal, the epitrochlear, and the cervical lymphatic glands, the skin, the mucous membrane of the mouth and fauces, the eyes, and such portions of the bones as are covered only by skin, must be examined. It is not often, when an obscure affection is really syphilitic in its nature, that such an examination will not reveal some other symptom of the disease.

In doubtful cases the effects of an antisyphilitic treatment with the iodide of potassium, or even with mercury if the suspicion is very decided, must be tried.

In the diagnosis of *visceral syphilis* and of syphilitic marasmus, the remains of former affections, especially those of the bones, the fauces, and the skin, are frequently the only data for the formation of a diagnosis.

The diagnosis of *hereditary syphilis* is not usually attended with any difficulty in early childhood; the affection of the nasal mucous membrane, the papular or pustular rash, and the puny and aged expression of the child, form a group of symptoms that can scarcely be misinterpreted. It must not be forgotten, however, that children with hereditary syphilis may be well developed at birth and present the appearance of perfect health, affording no further evidences of syphilis than a few condylomata about the anus.

Of much greater practical importance is the question which sometimes arises subsequently, whether the subject of certain affections had, during earlier life, symptoms of hereditary syphilis. In this respect the signs which have been brought prominently forward by Hutchinson are of the utmost importance. The most typical of these are the following: prominence of the frontal protuberances, flatness of the tip of the nose, interstitial keratitis or cloudiness of the cornea, fine white linear cicatrices radiating from the angles of the mouth or nostrils, and particularly that condition of the permanent incisor teeth which is well shown in the wood-cut from Hutchinson's article in Reynolds's System of Medicine, which is here given.



The presence of all, or even of only the chief, of these features gives to children with hereditary syphilis, and even to adults, who may moreover have lost the deformed incisors, such a characteristic physiognomy, that, if well-marked, it can be recognized at a glance. If there is any suspicion of syphilis in the younger children of a family, the elder ones should always be examined, since in them the evidences of inherited syphilis are often to be found in a still more marked degree.

PROGNOSIS.

From what has already been said it can be seen that syphilis under all circumstances must be looked upon as a dangerous disease, since it is active throughout the entire organism for a long time, and often leaves permanent injuries of some organs. Indirectly, therefore, syphilis may often be the cause of death. It is seldom the direct cause, except among children with the disease in its hereditary form, a large majority of whom die at a very early age.[1] When we reflect that quite as many deaths occur from the same cause during the fœtal condition, we may form some idea of the baneful influence of syphilis upon the mortality of a population. All trustworthy data necessary to the estimation of the entire number of deaths from syphilis are as yet wanting, for even deaths which are directly due to this disease are not always put under this head in the lists of mortality. How many cases of deaths among young children, which are really from syphilis, are recorded under the terms atrophy or marasmus! Among adults death as an immediate result of syphilis is very rare, and when it occurs it is usually due to loss of blood in consequence of ulceration, or to exhaustion following an unusually severe course of the acute stage. If all the cases in which syphilis, by causing affections of the brain, of the heart and blood-vessels, of the liver, or of the kidneys, becomes a remote cause of death, were attributed to their true source, the list of deaths from this disease would in many localities be much augmented. Thus far all estimates of the proportion of deaths among those affected with syphilis are equally untrustworthy. No just idea of this mortality can be obtained from the statistics of the venereal wards of hospitals, for fatal forms of syphilis are there found in but small number, but should be sought for in the wards for internal or surgical affections and in the almshouses.

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[1] In London during the twelve years 1854–65 there were 3,370 deaths from syphilis, 2,587 of these being children under one year. (Brit. Med. Journ., 1868, Vol. II. p. 116.)

In regard to the prognosis in individual cases, it has already been stated above that there are mild and severe cases of syphilis to be distinguished. In these latter, in which the first eruption is frequently pustular, and in which the primary sore itself may take on a gangrenous character, the life of the patient is often in immediate danger. Within certain limits it is possible to estimate the severity of the future constitutional involvement from the character of the primary sore. If phagedæna, or rapidly destructive suppuration in the primary lesion be not due to contamination with hospital gangrene or to inappropriate treatment, the conclusion which must be formed as to the constitution of the patient must lead to grave forebodings as to the effects of the later stages of the disease. In the opinion of many physicians, the presence of a very extensive primary lesion, with marked induration, indicates that the subsequent course of the disease will be severe. In so far as we are warranted in making the supposition that an intense and extensive induration is due to a more profound contamination of the tissues, and that there is thus furnished a more prolific source of the syphilitic virus for infecting the rest of the organism, to just that extent may the opinion given in the last sentence be held. But numerous exceptions to this rule are met with, in which, for example, a well-marked eruption follows an insignificant primary lesion, and it is always venturing a good deal to attempt to foretell anything beyond the acute stage.

It cannot yet be decided whether the severity of the course of the disease is influenced by the locality at which inoculation takes place. Some cases of infection on the fingers, of which I have knowledge or which were under my observation, have given me the impression that such cases are apt to follow an exceptionally severe course. Cazenave also narrates several cases of this kind which were characterized by severe symptoms; and he attributes this to the unusual way in which infection took place in the autopsy of a syphilitic subject, or the delivery of a syphilitic woman while there was a wound on the finger. In some of these cases, the severity of the disease may be due to the fact that the attack was not at first recognized and treated as syphilis, as has happened in many cases of vaccinal syphilis. The character of the rashes which appear during the eruptive period forms a trustworthy ground for the formation of a prognosis. Not only is a roseola in itself a lighter affection than a papular, or especially than a pustular eruption, but it has less influence upon the later course of the disease than the more enduring exanthem, since the latter, during its existence, is constantly contaminating the blood by a fresh proliferation of syphilitic virus in the various local deposits. If this is true, it does not accord with the assertions of many authors, that there is a greater predisposition to tertiary affections, especially in the bones and internal organs, among such as have had but slight cutaneous manifestations. This view, however, is not yet supported by a sufficient number of observations, and it must also be borne in mind, first, that there is no necessary relation of cause and effect in these cases, since the antecedent syphilitic affections are not the only elements which influence the appearance of tertiary symptoms; and, second, that the constitution of the patient and external influences also play an important part.

Roseola must be regarded as the mildest form of eruption; papular forms are more grave in character, and a pustular rash, especially one that consists of tubercles, is of still more unfavorable omen. In all cases of syphilitic local affections the more nearly the results of the process approach the character of gummy tumors, that is to say, the greater their tendency to softening or to cheesy degeneration, rather than to resolution, the graver, as a rule, is the prognosis. This distinction in the danger attending deposits of these respective characters, is due to the fact that those of the secondary period consist of a simple infiltration of cells, which is persistent, but still capable of removal by absorption, while those deposits which are tertiary in their character undergo rapid changes which lead to destruction of tissue. This distinction is dependent, too, on the importance of the affected organ. A simple proliferation of cells, which after some time is either absorbed or converted into connective tissue, has a very different significance according as it affects the skin, or a bone, or the iris, or the adventitia of an important blood-vessel of the brain.

Although the prognosis as to the results of cases of this sort must always be grave, we must remember, on the other hand, that many serious affections, more especially some of those of the nervous system, even such as epilepsy, various paralyses, aphasia, and the like, when not of too long duration, are more favorable in their course when due to syphilis, since an anti-syphilitic treatment sometimes removes morbid conditions, which are apparently hopeless. Care must be taken, however, not to give a too favorable prognosis, especially in cases of syphilitic affections of the nervous system, for anatomical changes which cannot be removed are often at the bottom of the symptoms, or a temporary cure is followed by a recurrence of the affection.

The prognosis in a given case is greatly influenced by the patient's general condition at the time. If this bears a certain relation to the local symptoms, the prognosis is more favorable than when great weakness, anæmia, and wasting are met with in conjunction with apparently unimportant local manifestations. This statement is especially true with regard to the secondary period. In the tertiary period a cachexy of high grade may exist with limited affections of the skin or bones, and in a short time, under the influence of an anti-syphilitic treatment, the local symptoms may vanish, with marked improvement in the general condition, and the patient may ultimately regain his flesh and present a healthy appearance. But if this result is to be attained, there must be no serious visceral changes, especially of the liver and kidneys, and, above all, no intestinal ulcerations. While albuminuria may be relieved and even cured in some instances, dysenteric symptoms, when due to the lesions of syphilis, almost invariably lead to speedy death. Well-marked marasmus in syphilitic persons, particularly in those who are advanced in years, is of grave omen, even if the administration of the iodide of potassium, or other remedies, suffices to remove some of the local symptoms. Such patients frequently die from some intercurrent inflammatory affection, such as pneumonia, or, more commonly, erysipelas, which starts from some point of ulceration on the skin or nasal mucous membrane.

As in all diseases, the constitution of the patient has an important influence upon the course of syphilis, and, consequently, upon the prognosis. It is in differences in this respect that we must seek for explanations of the varieties which are seen both in the primary lesions and also in the later manifestations. Carmichael assumed the existence of several varieties of the syphilitic virus to account for these differences, but Cazenave taught that the constitution of the patient was the most important factor in determining the character of syphilides. Scrofulous individuals, and those who are prone to suppuration, are apt, when affected by constitutional syphilis, to suffer from pustular cutaneous eruptions and suppurative affections of the mucous membranes.

The *age* of the patient has a great influence upon the prognosis. The great danger to infant life from hereditary syphilis has been already pointed out, and this danger is not much less when children acquire the disease from their nurses, or in other ways, at a very early age. With children, the danger is due to the intensity with which the disease develops and runs its course; in the aged, to the slowness with which waste is repaired in the senile organism. Old people, therefore, are placed in peril by syphilis, and, at all events, the disease in them runs a more chronic course, even if the symptoms are not very severe.

Sex influences the type of the disease more than its intensity. Among women it is more apt to lead to anæmia of a high grade, and to functional diseases of the nervous system, than among men, and for this reason the symptoms of the early part of the secondary stage, in the former sex, often lead to the supposition that the patient is suffering from chlorosis, phthisis, or some disease of the spinal cord. Moreover, in women, menstruation, pregnancy, and the change of life affect the course and prognosis of syphilis.

The *habits* of the patient may also modify the course of the disease to a great extent. Those who devote their nights to dissipation, more especially if they are addicted to the excessive use of alcoholic drinks, or are already suffering from chronic alcoholism, are very unfavorable subjects for syphilis, and they often, when once attacked by it, are never entirely freed from some of its manifestations, and their lives are often manifestly shortened by it.

Finally, the prognosis is to a great degree influenced by the *treatment* which is pursued, or which has been already employed. It cannot be denied that a mercurial treatment, which *quickly* causes salivation and other evidences of mercurialism, while it has but little influence on the syphilis, may cause great injury to the constitution of the patient, and, in conjunction with unfavorable hygienic circumstances, lead to a scorbutic condition.

On the other hand, it is possible, by a judicious administration of mercury, not only to cause a disappearance of certain symptoms, but to render the disease less severe in its course, and indeed almost to cure it. The favorable effect of the iodide of potassium upon cases presenting the gravest symptoms, may cause the reversal of an unfavorable prognosis ; but it is not well, under such circumstances, to be too hopeful as to the future. The action which an anti-syphilitic treatment has upon the symptoms of the disease is often the measure of the severity of the affection and of the activity of metamorphosis, and thus furnishes important data for the formation of a prognosis.

The question of the possibility of the *cure* of syphilis, which is of such great prognostic importance, is one which has interested physicians from time immemorial, and one which has often been answered in the negative. We now know with certainty that a patient may entirely recover from syphilis, and that, too, in a comparatively short time ; for the occurrence of cases of second infection, some years after first contracting the disease, has been abundantly proved. We know also that a spontaneous cure of syphilis may take place at any stage. This is established as to the primary stage of, among others, the cases of intentional inoculation which were observed by von Rinecker and by the anonymous surgeon of the Palatinate (see p. 103), and numerous cases in which an expectant treatment was employed by Hutchinson, Diday, and others, prove the truth of the assertion as to the secondary stage. Tertiary manifestations are only capable of cure in proportion as the loss of tissue which they involve does not affect tissues, organs, or localities of great physiological importance. It is to be regretted that we possess no criterion of the actual cure of syphilis; when we see, after the acute stage, a period of many years of undisturbed health, and the procreation of healthy offspring, it is highly probable that there has been a complete and permanent cure, but there is no absolute certainty as to the future.

TREATMENT.

Prophylaxis.

In dealing with a disease which is propagated by a fixed contagion, the hope might be entertained that it would be possible, by a strict prophylaxis, not only to cause a diminution of it, but finally to effect its disappearance. This was recognized as early as the first epidemic outbreak of syphilis, as may be seen by the strict rules for the isolation and confinement of the syphilitic which were promulgated at the end of the fifteenth century. But as to syphilis, which spreads principally by sexual intercourse, there are difficulties in the enforcement of prophylactic precautions which have as yet never been fully surmounted. If it is difficult in a small, enclosed territory to limit to the infected individual a disease which for months is directly contagious, and for years communicable to his offspring, it is well-nigh impossible to effect it in localities which are in frequent and close communication with others in which all prophylactic precautions are neglected. With the intimate relations existing at the present day between all parts of the world, syphilis is constantly transported from one place to another.

Prostitution is the source whence the syphilitic virus is ever freshly drawn, and the first effort towards effecting any prophylaxis of syphilis should include some sort of supervision of prostitution, since the experience of thousands of years has shown it to be an unavoidable evil, the suppression of which is impossible.

That an official supervision of this kind has the most favorable influence in diminishing syphilis, has been proved by the results which have been attained whenever a strict control has been substituted for the freedom or insufficient sanitary rules which had previously existed. This has been seen in Belgium

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and in England, where quite recently a supervision and examination of the notorious prostitutes of the garrison towns has been practised, and where the condition of the troops has been much improved.[1]

A full consideration of this question, which is of such extraordinary importance for the public health, would be out of place here. We must limit ourselves to the statement of some of the principal points, which, however, as fundamental principles, are pretty generally recognized. It is the duty of the State, in the interest of the health of its citizens, not only to limit prostitution, but to exercise a supervision over it, for it has been found everywhere that the secret, unwatched prostitutes are far more active in the spread of syphilis than those who are subjected to regular inspection. For the attainment of this end, it has the right, in the interest of all, to limit the personal liberty of such persons as may be considered dangerous to the common welfare, and to use force, if necessary, to obtain an examination as to the condition of their health. Regular, frequent, and thorough examinations are necessary; and they are in most cases of great benefit to those subjected to them, since they afford them an opportunity of being cured by timely treatment. Although it is desirable and necessary to furnish all inducements to these unfortunates to enter the hospitals voluntarily, still it has been found that but few avail themselves of this privilege, and how little influence the free treatment of all syphilitic patients at the cost of the state has in diminishing the prevalence of the disease, may be distinctly seen from what has taken place in Finland.[2]

Up to the present time, it has been everywhere found that just that class of prostitutes who are the most apt to spread syphilis will not subject themselves to treatment, except under compulsion. The action of the State, or of a community, may go still further in this direction. Prostitutes, when brought under the discipline of the establishments maintained for their treatment when diseased, can be subjected to influences which may induce, at least some of them, to give up their old calling and adopt some respectable means of earning a livelihood, as is shown by the favorable results that have been attained under the laws which have been in force in England during the last few years.

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[1] A Parliamentary Commission reported in the year 1871, that in those districts in which the "Contagious Diseases Act" had been enforced, the number of soldiers affected with venereal disorders in one thousand had diminished from one hundred and twenty to fifty-four, during the period from 1865 to 1870.

[2] Compare the interesting paper of *O. Hjelt*, Die Verbreitung der vener. Krankheiten in Finnland. Berlin, 1874.

At all events, all prostitutes found to be syphilitic should be kept in a hospital until they are cured. An ambulatory treatment precludes the attainment of one important object, that of rendering them powerless for evil while their disease is in its most dangerous stage. How long such patients should be detained, is a very important question, and one that is difficult to answer; for, while all such cases need careful consideration, those which are not to be under supervision after their discharge demand still more careful scrutiny.

It has been often urged that entire classes of *men*, who notoriously contribute largely to the spread of syphilis, as for instance soldiers and sailors, should be subject to periodical examinations, and that sailors especially should be inspected before leaving a port, and again before entering another, and that if found infected they should be placed in quarantine. The workmen in some of the glass-works in the neighborhood of Lyons have of their own accord demanded such examinations, to do away with the possibility of infection from the tubes used by them for blowing glass, which are passed from mouth to mouth.

Finally, it can scarcely be doubted that the authority of the state warrants the *punishment of* a person who has knowingly infected another with such a disease as syphilis. The laws of various German countries formerly contained definite statutes on this point, but they are not included in the Imperial Criminal Code of the 15th of May, 1871; however, the decree in regard to punishment for injuries to the person, whether caused by negligence or by design, might be applied. It is possible that in some countries there may still be definite police regulations in respect to this matter.

With the unbounded intercourse between different countries which has been developed in recent times, thorough efficiency cannot be attained by means of prophylactic regulations that are enforced only by individual states. It is the duty of all civilized states to adopt a common course of action against these diseases, and there is a need of universal prophylactic regulations that is being more and more widely recognized.

In framing prophylactic rules, it must be borne in mind that syphilis, during a portion of its course, is capable of being communicated from its local manifestations, and during a much longer period can be transmitted to the offspring of those affected with it.

During the secondary stage, therefore, the use of such drinking utensils, plates, towels, etc., as are used by others, should be avoided by infected persons. Especial watchfulness should be exercised to prevent the contamination of surgical instruments, which may through negligence become vehicles of contagion. By far the most important example of infection of this character is vaccination, and from the facts detailed above (see p. 61 et seq.) the following rules may be drawn :

If possible, only children whose parents are known to the physician should be used as sources of vaccine matter. If there exists the slightest suspicion that either of the parents is affected with syphilis, although the child may be apparently in perfect health, no vaccination should be performed from it. Since hereditary syphilis in a large majority of cases manifests its existence before the expiration of the third month of infant life, it is advisable to vaccinate from children above that age, and if possible from such as have attained the age of six months. It is safer also in doubtful cases not to vaccinate from the *first* children of any given parents, although it is quite possible that those born subsequently may be syphilitic, while the earlier ones are healthy, since the parents may have contracted syphilis after the birth of some of their offspring. A child from whom it is proposed to vaccinate others must be examined by the physician with special reference to the discovery of any possible symptoms of syphilis. It must be entirely stripped, and the anal region in particular should be subjected to close scrutiny. Special care should be taken to ascertain if coryza or a light grade of hydrocephalus is present, and if either of these symptoms is discovered it should prompt careful inquiry. Great care should be exercised to avoid the inoculation of blood, or of serum which has exuded from the vaccine pustule some time after it has been opened. Adults should never serve as vaccinifers. Finally, in case a number of children or adults are to be vaccinated at one sitting, those of them who may be suspected of being syphilitic should be separated from the others, and the conveyance of their blood to the vaccinifcrous child, or to the healthy persons who come after them in turn, should be most carefully guarded against.

The choice of wet-nurses for healthy children places quite as heavy a responsibility upon the physician as does vaccination. It is not only necessary to make a thorough examination of a wet-nurse, devoting special attention to those parts of the person where traces of syphilis are apt to be found, such as the genitals, the mouth and throat, the lymphatic glands, and the bones; but, if possible, it is well to inspect also any children that she has previously nursed. Any symptoms that arouse the least suspicion of syphilis should suffice for the rejection of the nurse. It is no less necessary to prevent children with hereditary syphilis, or those upon whom a suspicion of latent syphilis rests, from being given to healthy wet-nurses. In countries in which the custom of employing wet-nurses prevails, the greatest care must be exercised in these matters, and strict laws, inflicting a severe penalty for careless inoculation of syphilis upon healthy persons, should be enacted and rigidly enforced. A syphilitic child may be nursed by its mother, if she has herself previously had symptoms of syphilis; but, if she has never had such symptoms, it is safer to forbid her to suckle her child, although the risk of her contracting the disease from it is but slight.

The physician must on no account delay to inform those having the charge of syphilitic children of the danger of infection through kisses or the use of its eating and drinking utensils, etc.

The question of the propriety of matrimony, in the case of persons who have recently or at some previous time had syphilis, is of great importance from a prophylactic point of view. Improbable as it sounds, it is not of rare occurrence, in countries in which marriage is not surrounded by many obstacles, for men with active syphilis to marry, even in spite of medical advice, and speedily to infect their wives. Although as long as the slightest trace of syphilis can be discovered, there can be no doubt that a decided negative should be given by the physician to all such inquiries, it is extremely difficult to state how long a time must elapse, after the disappearance of all symptoms, to do away with all danger of infection. In such cases it is impossible to give a positive answer. When a man has enjoyed one, or still better, several years of undisturbed good health after the disappearance of all symptoms of syphilis, he may be allowed to marry; but, although under these circumstances there is no direct danger of his infecting his wife, there is no certainty, but only a strong probability, that his offspring will be healthy. The difficulty above referred to, that there is no absolutely certain sign of the complete cure of syphilis, is nowhere more manifest than in the consideration of this question. We must here content ourselves with having pointed out the principles by which the physician must be governed. An accurate knowledge of syphilis, and especially of the facts relating to its transmission, combined with tact and knowledge of the world, will put him in a position to give a decision for the best interest of his patients, and the community at large, in those difficult and involved questions which are so often met with in practice. For a more thorough consideration of the points which arise in this connection, we refer to the brochure of Langlebert, which has recently appeared.[1]

From what has been said above in regard to the different means of contagion, the rules which an individual should observe in order to preserve himself from infection may be inferred. It is not our object to go more deeply into this matter, to enumerate the rules proposed by physicians as early as the fifteenth and sixteenth centuries, or to give the numerous lotions and the like which have been recommended as preventives, and it is only on account of its historical interest that we will state that it was seriously proposed to introduce syphilization as a prophylactic, from its analogy to the inoculation of the virus of variola (Auzias Turenne).

TREATMENT.

Aphrodisiacus: Full accounts of the treatment with mercury are given by the various writers of this collection, *e.g.*, by *J. Widmann*, *G. Torella*, *Cataneus*, *de*

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[1] La Syphilis dans ses rapports avec le mariage. Paris, 1873.

Vigo, and others; while *L. Schmaus*, *U. von Hutten*, and *N. Poll* have discussed more particularly the merits of guaiacum. *Delicado's* brochures, already quoted on page 9, also treat especially of guaiacum.—Mercurial Treatment: *J. Hutchinson*, On the Use of Mercury in Syphilis. Paper read at the Hunterian Society of London, Jan. 8, 1874, Med. Times and Gaz., 1874, Vol. I. p. 79.—*v. Sigmund*, Die Einreibungscur mit grauer Salbe bei Syphilisformen. Wien, 1859.—*B. Brandis*, Grundsätze bei Behandl. d. Syph. Berlin, 1870.—*J. E. Güntz*, Die Einreibungscur b. Syph. in Verbindung mit Schwefelwässern. Leipzig, 1872.—Internal Use of Corrosive Sublimate: *v. Sigmund*, Wien. med. Wochensch., 1873, Nos. 15, 18, 19, 31, 35.—Hypodermic Injections of Corrosive Sublimate: *G. Lewin*, Annal. d. Charitékrankenhauses in Berlin, B. XIV., 1868.—*Uhlemann*, Wien. Med. Presse, 1869, No. 13.—*Grünfeld*, Ibid., Nos. 17, 20, 24, 28.—*v. Sigmund*, Wien. med. Wochenschr., 1869.—Hypodermic Injections of Calomel: *Ragazzoni* and *Appiani*, Giorn. ital. delle malatt. ven., etc., Aug., 1870, quoted in Arch. f. Derm. u. Syph., B. III. p. 98.—Ibid., p. 478.—Iodine: *Wallace*, Lancet, 1836.—*S. A. Lane*, Lancet, 1873, July 26.

In the treatment of syphilis the first question which arises is, whether the virus can be destroyed at the point of infection, and its absorption into the organism prevented. Since we have already stated, that the primary affection is not the first local expression of a general blood-poisoning, but the action of the virus which is for a time limited to the point of infection, the answer to this question has a special significance.

A great difficulty, and one which, at all events, is the cause of such frequent failures in the attempt to cut syphilis short in the primary stage, lies in the fact that the infection in many cases does not manifest itself at the point at which the virus entered until after a period of incubation of some weeks. It is therefore not to be wondered at that the observations which have been reported in regard to this question are conflicting.

Hunter,[1] who looked upon the primary lesion as a purely local affection, and therefore cauterized or excised it, did not omit to call attention to the fact that the result was uncertain, since there was no positive evidence of the extent to which the tissues were diseased. Cazenave,[2] who holds the opposite view as to the nature of the primary lesion, expresses himself distinctly as discountenancing attempts of this character.

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[1] L. c., p. 331.

[2] L. c., p. 177: "Le symptôme primitif, quel qu'il soit, est toujours l'expression locale, plus ou moins tardive, d'un état général." P. 182: "à mes yeux elle peut avoir des conséquences funestes."

However, such attempts are constantly being made, and favorable results are obtained from an abortive treatment of this kind, not only in cases in which the local manifestations are seen almost immediately after infection (v. Sigmund),[1] but also in those in which the primary lesion had developed in the usual way, and in which, from the presence of the induration, there could be no doubt as to the syphilitic nature of the affection. Humphry,[2] of Cambridge, Hüter,[3] v. Langenbeck, and also P. Vogt,[4] have published a number of cases in which the results were favorable. On the other hand, Bumstead has abandoned this treatment, and Berkeley Hill reports a case in which he cauterized a wound on the frenulum with fuming nitric acid about twelve hours after coitus, but still the cicatrix became indurated, and was followed in due time by constitutional syphilis. Upon this he grounds his conviction of the uselessness of such abortive methods. V. Lindwurm[5] and others have tried the same methods repeatedly, but without success.

Still, however, the positive results that have been attained give encouragement for fresh attempts in such cases as are peculiarly suitable for this mode of treatment, in those, for instance, in which the primary lesion is on the edge of the prepuce or on one or the other of the labia minora, or in which there is a papule with sharply defined limits, and even the presence of a slight amount of lymphatic enlargement in the groin does not necessarily contraindicate the excision of the papule. The radical removal of the deposit at the point of infection must not be allowed, however, to excite too much hope.

If, soon after infection, the initial lesion takes the form of an ulcer, it should be cauterized during the first two or three days with fuming nitric acid, or, according to v. Sigmund, with a solution of sulphate of copper (two drachms to the fluid ounce), or with concentrated carbolic acid. An ulcer of this character is frequently only a chancroid; but if the virus of syphilis has been inoculated at the same time, there is nevertheless some prospect of destroying it by converting the chancre into a simple ulcer by cauterization.

If the primary lesion is too far developed, or if its location forbids abortive treatment, it is sufficient, when dealing with simple erosions, or with superficially ulcerated indurations, to keep them clean by frequent washings, or by means of sitz-baths in the case of females, and to dress them with moistened charpie, changed several times daily for the purpose of promoting cicatrization, which may occur while the induration is still perceptible or even advancing. If there is much suppuration, it is advisable to use an astringent solution of the acetate of lead or sulphate of copper. In treating large ulcerating indurations, it is well to use lotions containing mercury, such as the "black wash," of the strength of eight grains of calomel to the fluid ounce of lime-water, or perhaps still weaker, as five, or even three[1] grains to the fluid ounce. If corrosive sublimate be used, it must be in extremely dilute solution, for even in the proportion of a grain to the fluid ounce, it will not be borne for any length of time by the uninjured mucous membranes. Salves cannot be used to advantage in the treatment of syphilitic primary lesions.

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[1] Wiener med. Wochenschrift, 1867, Nos. 43, 44, and 64.

[2] Med. Times and Gazette, 1864, Vol. II., p. 181.

[3] Berliner klin. Wochenschr., 1867, No. 27, p. 287.

[4] Ibidem, 1871, No. 38, p. 455.

[5] L. c., p. 154.

Phagedæna is best treated after the method of Hutchinson and Zeissl, by permanent baths in connection with irrigations, for which a solution of the permanganate of potash may be used. In a few days the dead tissues become separated and the sore begins to granulate. The cauterizations with fuming nitric acid, which were formerly employed, are seldom followed by a limitation of the process, and frequently the destructive action proceeds with all the greater rapidity, so that, partly by the morbid process, and partly by the cauterization, the whole organ may be destroyed. The administration of opium, which has been so much praised, can only allay the general discomfort of the patient, who is usually sleepless and much reduced; but in this respect it is of great service, and should not be omitted.

The treatment of primary lesions, having the form of chancrous ulcers, when cauterization with fuming nitric acid is not feasible, consists principally in keeping them clean and dressing them with a moderately astringent solution, a weak sulphate of copper solution being particularly serviceable. Recently iodoform[2] has been much praised as a remedy, which, if dusted upon chancres, will deprive them of their specific character, and convert them in a few days into granulating surfaces. As it also possesses slight anæsthetic properties, it may be used likewise in the treatment of painful phagedænic ulcers.

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[1] Equivalent to the *Black Mercurial Lotion* of the British Pharmacopœia.

[2] *H. S. Purdon*, Dublin Journal of Med. Science, 1873, p. 51.

Complications of the primary lesion, such as phymosis, paraphymosis, and suppurating buboes, must be treated according to surgical principles. When there are ulcerating indurations in the sulcus glandis, and phymosis occurs, division of the prepuce is often indicated in order that the surface of the ulcers may be kept clean and remedies applied directly to them.

Ought the primary lesion to be treated by the internal use of anti-syphilitic medicines? This question presupposes an answer to the other, Are there remedies which act as direct antagonists to the virus of syphilis? In accordance with the experience of the last three centuries in the treatment of syphilis, the answer to this question must be, that *mercury* appears to be such a remedy.

Mercury was in use as early as the end of the fifteenth century, and apparently Widmann (1497) was the first to employ it. It was then used by Italian physicians, for example by Petrus Pinetor (1500). The favorable results of its action upon many cutaneous affections, which were known to the Arabian physicians, probably led to its first use, originally in the form of salves and fumigations, in the treatment of syphilis.

The esteem in which this drug has been held by physicians of different times, has been very varied; while at one time it has been praised to the skies, at another it has been reviled as the most deadly poison, and been almost accused of being the source of the symptoms of syphilis. The strife between the mercurialists and the anti-mercurialists has been, especially at times, a very active one; and even our own times have seen some revival of the old conflict; and while a recent French author[1] would put mercury in the museum of therapeutic relics, J. Hermann[2] demands that government shall by law forbid its use. For a detailed account of the vicissitudes which the use of mercury in the treatment of syphilis has undergone, we refer the reader to Kussmaul's work, and to the historical studies of Proksch, which have recently appeared, and I will only state that the opposition to the use of this drug, which has sprung up from time to time, had its origin, especially in earlier times, in its abuse. Originally employed by the quacks, into whose hands, as shown by passages in the various authors collected by Luisinus, as well as by statements in old chronicles, the treatment of this disease has always been willingly entrusted by the public, the remedy was soon adopted by physicians, and it is doubtful whether the empirical treatment of the former or the modes sanctioned by the faculty, which were employed by the latter, did the greater amount of injury to the patient. When we read the descriptions of these modes of treatment, even that of the inunction cure introduced in the present century by Louvrier-Rust, we are reminded of the torture chambers of the Middle Ages, and can understand the truth of the statement of D. Abercromby, that many thought death itself less terrible than the tortures of a treatment by salivation. Salivation, up to the secretion of several pounds of saliva daily, was, and remained, the object of all mercurial treatment, in spite of the protestations of Astruc and others, who did not entirely condemn the use of mercury. It is only in modern times that physicians have abandoned this fatal error; and v. Sigmund rendered a great service in showing that salivation, so far from being necessary for the favorable effect of mercury on syphilis, was really injurious.

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[1] *A. Després*, Traité théorique et pratique de la Syphilis ou infection purulente syphil. Paris, 1873.

[2] *J. Hermann*, Ueber die Wirkungen des Quecksilbers auf den menschl. Organismus. Teschen, 1873.

Freed from this and other abuses, mercury, in spite of the violent denunciations of some modern anti-mercurialists, has again risen considerably in the estimation of the physician of recent decades ; for no unprejudiced observer can deny that its action upon syphilis is quite evident. This is nowhere better shown than in its action upon the cutaneous manifestations of syphilis. It is indeed true that exanthemata, of light grade especially, may undergo spontaneous cure; but when cases treated with mercury are contrasted with such as have been treated upon the expectant plan, there is no comparison between the course of the symptoms in the two instances. Under mercurial treatment the manifestations vanish completely in the course of a few weeks, while under the expectant treatment they may last for months with unabated intensity. That mercury produces these results, not alone by changes in the general nutrition, but that it has also a direct local action upon the diseased parts, has been proved by the results which followed the hypodermic injections of corrosive sublimate made by Ch. Hunter, Hebra, Köbner, and others. In Köbner's[1] case, a confluent papular syphilide about the shoulder rapidly became paler in color after the hypodermic injection of corrosive sublimate into its centre, while an equally large patch of the eruption situated in the lumbar region remained unaltered. Monti[1] noticed that flat condylomata in children rapidly disappeared when such injections were made into them. An analogous, but slower, action is seen when a plaster containing mercury is applied to syphilitic affections of the skin, or when a mercurial salve, such as the oleate of mercury, is frequently rubbed into the skin. If mercury is given internally, or rubbed into the unbroken skin, its action upon local affections is less rapid, but no less evident.

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[1] Archiv f. Derm. u. Syph., B. I. p. 628.

This action is also manifested when a general mercurial treatment is commenced while the primary induration is still present. If it is of small size the papule will be speedily absorbed; if an extensive and well-marked induration is present, the action of the remedy is manifested more slowly. This action is shown not only upon the primary, but also upon the constitutional affection, by the postponement of its outbreak, as has been established by numerous observations. Indeed, according to the testimony of Ricord,[2] and more recently of Hutchinson, it is possible, by a well-timed mercurial treatment, to prevent constitutional infection, that is, to limit the manifestations of syphilis to the primary lesion, and to cure the disease in its primary stage. These authorities express themselves in perfect accord as to this point. This declaration, coming from Hutchinson, has all the more significance, since he denied, some years ago, in his article in Reynolds's System of Medicine, that the outbreak of secondary symptoms could be prevented by mercurial treatment, and stated that, if they did not occur, their absence could not be attributed to the treatment, although it might cause them to be of a less severe character. Hutchinson has in the meanwhile become convinced of the contrary, especially by the observation of cases of vaccinal syphilis; and when such a prudent and careful observer as he is finds reason to modify his former view, especially in a matter of such importance, it behooves his compeers to study the question with great earnestness. In the above quoted interesting discourse before the Hunterian Society, he expressly calls mercury an antidote to the syphilitic virus, which is destroyed by it, prevented from proliferating itself in the blood, and restrained in its effects on the tissues, in case it has already got so far in its action.

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[1] Jahrbuch f. Kinderheilkunde, 1869, 4 H.

[2] Transact. of the Surg. Section of the Brit. Med. Association, 1872. Brit. Med. Journal, 1872, Vol. II. p. 187.

Since we recognize syphilis only by its effects on the tissues, the influence of mercury upon it is to be known only by the alterations which take place after its administration in the manifestations of the virus of syphilis; the intimate nature of its action is still veiled in obscurity. The action of mercury on syphilis was formerly thus defined: the local affections due to syphilis disappeared more rapidly under its use, but the syphilis itself was only rendered latent, and the poison circulating with the blood was left undisturbed. But if it is really possible, by a timely and systematic administration of mercury, to prevent the occurrence of constitutional syphilis, this view is no longer tenable. The action of mercury upon the syphilitic virus, is not, however, a simple chemical neutralization, for, were that the case, the largest possible quantity of the drug that could be absorbed in the shortest possible time would act the most certainly; whereas, we find that the opposite is the case, and that when, from large doses of mercury, salivation occurs, new localizations of the disease take place. The more nearly we approach to an utter avoidance of the physiological effects of mercury on the system, provided it exercises a sufficient influence on the manifestations of syphilis, the surer we are of obtaining beneficial results. Among the phases in the history of the treatment of syphilis, when mercurial treatment was thrust into the background, there are deserving of mention the introduction of guaiacum, and other drugs of vegetable origin, which were used in compounding the various infusions made from woods, the purely expectant mode of treatment, the so-called "simple treatment," introduced at the time of the Portuguese war in the early part of this century, and finally the administration of iodine, the introduction of which among the means used in the treatment of syphilis was principally due to Wallace.

Guaiac wood, which was first employed in Spain, in 1508, soon came into repute from the special virtues claimed for it in the treatises of Delicado, Schmaus, and U. v. Hutten. Among the Spaniards it was customary to make a trip to the West

Indies for the sake of taking the decoctions prepared by the natives themselves. E. Bassereau states that the custom continued in force during the whole of the sixteenth century. In Europe, in the meanwhile, confidence in guaiac had somewhat diminished, and other vegetable substances, as the "China root" (root of *Smilax China*), sarsaparilla root, and sassafras wood took its place or were used with it, without, however, being able to rival its reputation. Gradually these remedies were again thrust into the background by mercury, but have not even yet wholly lost their repute, for quite recently various voices have been raised in favor of the use of sarsaparilla, more especially in the treatment of tertiary syphilis. Exact researches in regard to the virtues of this drug would be of great value. The mode of action of this remedy consists in causing a more active tissue-metamorphosis by inducing sweating, purging, and increased diuresis, and it must not be forgotten that the loss of force to the organism which may be brought about by an immoderate excitation of these excretions, in conjunction with a very limited diet, may cause a disappearance of the symptoms of syphilis in the same way as, but with less rapidity than, by an attack of cholera, for instance. But that this result, in the acute period of syphilis, is attended by any permanent advantage, appears to me, in spite of the warm praise which v. Bärensprung gives this method of treatment, to lack proof.

Upon a similar theory, namely, a stimulation of metamorphosis of tissue, was based the so-called "simple treatment" of the English physicians in the beginning of this century. Some of these physicians, and more particularly J. Thomson and Thomas Rose, were induced by the observation of Ferguson, who saw this disease pursue a mild course among the Portuguese without the use of mercury, to adopt this mode of treatment. Their system consisted chiefly in strict prohibition of the use of mercury, rest in bed, very restricted diet, and the administration of antisyphilitic remedies, more especially of laxatives. Since, up to this time, all affections of the genitals, of venereal origin, had been treated with mercury, it was very striking to see that, without the use of this remedy, a large majority of their patients did not give any evidence of constitutional syphilis, and particularly that those severe symptoms which had previously been common, and for which the injudicious use of mercury had been partly to blame, were not met with. This method speedily found advocates in other countries of Europe, and in North America. These observations of the English physicians found a readier acceptance in France, owing to the prevalence of the doctrines of the "physiological school"[1] of Broussais, in accordance with which the specific character of syphilis was denied, and the disease simply classed among inflammatory affections. In Germany, Fricke and Kluge advocated the simple treatment. It was not long, however, before a reaction set in. In England especially, a too hasty judgment had been pronounced, and large experience induced even Thomson and Rose, the two principal promoters of this mode of treatment, to return to the employment of mercurials.[2]

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[1] Compare *Auspitz*, l. c., p. 58.

[2] *Berkeley Hill*, l. c., p. 274.

The experience of Wallace, of Dublin, with the iodide of potassium led to the belief that in this drug would be found a substitute for mercury, which so often worked mischief, and it was accordingly administered in all forms and stages of syphilis. The conviction was soon reached, however, that there were certain syphilitic symptoms which yielded to this remedy with marvellous rapidity, whilst others remained entirely unaffected by it. Physicians of the ripest experience are unanimous in the opinion that the preparations of iodine manifest their greatest influence on the symptoms of the tertiary period; on gummy affections in the most varied localities; on tubercular cutaneous eruptions and serpiginous ulcers, in diseases of the bones and periosteum, and in symptoms of disorder of the nervous system; while, on the contrary, affections of the skin belonging to the secondary stage, especially macular and papular exanthemata, are not at all affected by them. I have in numerous cases most thoroughly convinced myself of the truth of this, and quite recently Zeissl[1] has published accounts of some cases in which, after the administration of iodide of potassium for a period of several weeks, no change was noticed in papular eruptions. Zeissl, on the other hand, calls attention to the fact that iodine, in doses of two minims of the compound tincture,[2] properly diluted, twice daily, brings about a more rapid disappearance of affections of the mucous membranes than mercury does. Moreover, according to him, iodine in this stage exerts a weakening action on syphilis, so that after its administration a few mercurial inunctions suffice to bring about a permanent disappearance of the cutaneous rash. Upon primary affections the influence of iodine is scarcely perceptible.

The efficacy of iodine in tertiary syphilis is one of the most valuable weapons of the anti-mercurialists, for they conclude that, since the administration of iodine causes the excretion of mercury, if it be present in the organism, its favorable action in tertiary syphilis depends upon the liberation and excretion of the mercury which previous treatment had introduced into the body.

After this digression we now return to the discussion of the question stated above, as to the use of anti-syphilitic remedies in the treatment of the primary lesion.

Since, according to our view of the nature of the primary lesion, it is desirable to render its existence as short as possible by restraining it in its development, and since we possess in mercury a remedy which has an indisputable influence in this direction, we are of the opinion that as soon as it is established that a local lesion is syphilitic, the use of mercury should be commenced. In a majority of cases, indeed, it is not likely to be administered until the glands of the neighborhood show the first symptoms of indolent enlargement. If induration is developed in a suspicious erosion, particularly in one on the female genitals, or in an ulcer which began as a chancroid, and if the lymphatic glands of the part show a slowly increasing enlargement, the administration of mercury must not be delayed. Usually three, four, or even more weeks, reckoning from the date of infection, will have elapsed; for this treatment should not be entered upon until the suspicion that we are dealing with syphilis has grown almost to a certainty. In some cases we have to wait for the outbreak of constitutional symptoms.

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[1] Wiener med. Wochenschrift, 1873, No. 46.

[2] "Tinct. of iodine," British Ph.

So soon as the employment of mercurial treatment has been decided to be necessary, it must be carried out systematically, whether we are dealing only with a primary lesion or whether secondary symptoms have already appeared.

The patient must be informed of the importance of regularity in the treatment, and especially must he be made acquainted with the fact that, even in the mildest case, the treatment must be prolonged over several months.

If the syphilis is destroyed in the primary lesion, a treatment of three or four months' duration may suffice; if this is not attained, and secondary symptoms appear, then the treatment will have to be prolonged to six or eight months, for it should not be interrupted until all traces of the symptoms have vanished. Otherwise there is danger that the virus may be proliferated anew in some remaining local deposit, and again infect the fluids. This danger from a too early cessation or interruption of the treatment cannot be too strongly stated, and care must therefore be taken at the start to so arrange the administration of our remedies that it may not be interfered with by any unfavorable complication, especially salivation.

If due care is exercised in this respect, there need be no dread that a mercurial course begun in the primary stage will render the organism either so intolerant of the remedy or so incapable of experiencing its good effects that we shall be deprived of our best weapon when secondary symptoms appear. The treatment must be adapted to each individual case, and no definite assertion can be made, either as to the dose that is to be given or as to the length of time over which the treatment is to be continued.

One principle must be kept in view, namely, that the treatment must not only be continued until all manifestations have disappeared, but also for some time afterward, and the patient must, after the last symptom has gone, still keep himself for several months under constant medical supervision.

The influence of the remedy on the manifestations of the disease, and the tolerance of the patient's system, furnish the measure of the dose; and nothing beyond the slightest grade of mercurial stomatitis should be allowed to arise. A mild mercurial course of this kind will indeed have to be continued for a long time, but it can be done with safety. The employment of larger doses causes a more rapid disappearance of the manifestations, producing an apparent cure in three or four weeks, but it does not prevent relapses. I have seen this often enough, even in private patients, who take good care of themselves; and how often new outbreaks occur in hospital practice cannot be accurately determined, since many patients do not return for treatment except when the manifestations prove annoying to them. In spite of this, the number of those who return again and again with fresh manifestations is not small.

Fournier, who thinks that a long continuance of treatment is imperatively necessary, advises that it should be discontinued from time to time, in order to allow the system, which has become accustomed to the remedy, to regain its susceptibility. He continues the treatment for three months, then suspends it for one month, and then resumes once more the administration of mercury, even when no new symptoms have appeared in the interval. After a further treatment of from six to eight weeks, he pauses again for three months, and so on, so that, including the intervals, the patient generally remains about two years under treatment, during about ten months of which mercury is given, while the pauses in its administration occupy the remaining fourteen months.

I am unable to decide from experience whether this intermittent treatment possesses all the advantages which he claims for it; but this much I can say, that sometimes in obstinate cases, especially in such as are not brought under treatment until they have reached an advanced period, mercury, which even in increased doses seemed to have lost its power of affecting the manifestations of the disease, displays quite a different action after the patient has been compelled by his business to travel for a week or two by land or sea, and to give up all treatment during the time, resuming it subsequently. In similar cases the same result is sometimes attained by substituting another preparation of mercury. This leads to a much more important point —that of the *hygienic* management of the patient during a mercurial treatment. Formerly patients who were undergoing a mercurial course were kept in highly heated and unventilated rooms, as few changes of the bed and body linen as possible were allowed them, although perspiration was excited and maintained, and their diet was very much restricted. Fortunately these things belong to the past. V. Sigmund was the first to call attention to the great importance of proper hygienic conditions during a course of mercurial treatment. One question which arises at the outset is this: May a syphilitic patient attend to business during the treatment; can he leave the house, or must he be confined to his bed, or, at least, to his room? In urging the necessity of a treatment of long duration, we really answer this question, and it is scarcely necessary to state that unless some special symptom, such as fever, rheumatoid symptoms, iritis, or laryngitis, calls for a rapid induction of the mercurial influence, the patient may be allowed to go about in good weather. During the eruptive stage, unless the symptoms are of light grade indeed, and in the colder portions of the year, under all circumstances the patients had better be confined to the house, in some cases even to their beds, for a few weeks. For the rest, throughout the entire duration of the treatment, patients should, as far as possible, maintain both bodily and mental quiet. During the entire time of treatment they should go to bed at an early hour, should favor gentle perspiration during sleep, should wear flannel next the skin, and avoid great and sudden changes of temperature. It is of great importance that the air which they breathe should be fresh and pure.

If a patient is to be confined to his room, it is well that two rooms should be at his disposal, and if the weather is favorable, he should, if possible, take regular exercise out of doors. The diet should be simple but nutritious. Beer and wine should be allowed in moderation at his meals, but all spirituous liquors and any excess in alcoholic beverages should be most scrupulously avoided. Milk should be freely used when patients show a want of appetite for other nourishment, as is frequently the case among women, who often become quite anæmic when suffering with syphilis. I have often had opportunities of convincing myself of the favorable influence of a plentiful use of milk upon the course of this disease.

While mercury is being given internally, great care must be exercised in the choice of food, since catarrh of the stomach or intestines may readily be caused by any indiscretion. Articles containing acids, such as fruit, salad, etc., must be avoided, and if calomel is being taken, highly salted dishes must not be allowed.

During the administration of any mercurial preparations, the utmost care must be devoted to the condition of the mouth, to avoid, if possible, the occurrence of salivation. Morning and evening, after every meal, and once or twice during the night, the mouth should be rinsed out with water at a suitable temperature, and twice a day the teeth should be carefully cleansed with a brush. To the water used for cleansing the mouth, a small amount of some aromatic tincture, as tincture of myrrh, of Cologne water, or of some astringent preparation, may be added. Among the astringents most suitable for this purpose may be enumerated tincture of galls, tincture of rhatany, alum, or the acetate of alumina, as advised by Brandis. It must not be forgotten that the long-continued use of the last two preparations results in injury to the teeth, and on this account Brandis advises that, after using a mouth-wash containing the acetate of alumina, the patient should brush out the mouth with chalk and camphor. Chlorate of potassa (twenty grains to the fluid ounce) may be used as a mouth-wash, and its internal use, in doses of five grains several times a day, in water, may be practised from the beginning of the treatment, to ward off the occurrence of mercurial stomatitis.

As a prophylactic measure against stomatitis, and particularly when there are affections of the mucous membrane of the mouth present, the patient must give up smoking. It is quite common to see severe syphilitic affections of the mouth in those who are great smokers, and these affections are very apt to recur in such patients.

Warm baths are a necessary hygienic measure when mercury is used externally, but even when the medication is of an internal character, regular warm baths, by promoting the activity of the skin, have a favorable influence. If the patient is tolerably strong, Turkish baths may be substituted for ordinary warm baths, for they not only promote the general metamorphosis of the tissues by the active fluxion which they cause, and by their more permanent influence on the skin, but they also hasten the disappearance of syphilitic eruptions.

Vapor baths or douches, such as are commonly employed in Aix-la-Chapelle, have also a very favorable influence, especially when the inunction treatment is used, since they give rise to a more active cutaneous circulation, and thus render the skin better fitted for the absorption of the mercury. If it is desirable to produce a still stronger influence upon the tissue changes, the patient may be allowed to perspire for some hours after leaving the vapor bath.

The principal methods in which mercury is administered are the following:

Its outward use by inunctions with blue ointment. This is the oldest form of the mercurial treatment of syphilis; and although it has at various times fallen into disrepute on account of the improper way in which it was performed, it has of late, thanks to the judicious rules enunciated by v. Sigmund, again acquired considerable favor. For, although this method is annoying to the patient, and also uncleanly, it possesses the great advantage that it does not directly affect the digestive organs, and yet is very efficacious. It is possible that the digestive tract may be indirectly affected by this treatment, and according to Brandis a mercurial intestinal catarrh may arise, and compel a temporary cessation of the inunctions. With reference to the way in which mercury is taken up into the fluids, J. Neumann[1] has shown that the metal, in the form of little globules, enters the follicles, where it is apparently slowly converted into corrosive sublimate and absorbed.

In carrying out the inunction treatment, different parts of the skin must be chosen for the application of the frictions on different days, so that no one surface may be covered with the ointment for too long a time. If the skin is irritable, or if the frictions are made in localities where there is a heavy growth of hair, an eczema may be readily caused, which would compel a cessation of the treatment. For this reason, hairy portions of the body are to be avoided in the performance of these inunctions.

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[1] Lehrb. der Hautkrankh., 3 Aufl. Wien, 1873, p. 455.

It is best to observe, in accordance with the rule of v. Sigmund, a certain order in making the successive inunctions. On the first day they should be performed on the legs; on the second day on the thighs; on the third day on the abdomen and the sides of the chest; on the fourth day on the back, and on the fifth day on the arms; and at the expiration of this time, or after ten days, if the inunction is performed on but one side of the body daily, this regular course may be begun again.

The inunctions must be done methodically, with moderate pressure of the palm of the hand; and, if the patients are too weak, they must be performed by an attendant. The frictions should be made for ten minutes continuously at each place, and fifteen or thirty grains of the mercurial ointment should be used on one or both of the places chosen for the day.

From the experience of the physicians of Aix-la-Chapelle, the nurses who perform these inunctions upon several patients daily, run no risk of suffering themselves from mercurialism, although they use the naked hand simply smeared with soap, before beginning the frictions. The use of a tightly fitting glove of fine leather would prevent the disadvantage of wasting the ointment.

Before the daily inunction is made, the patient should take a warm bath; or, if his circumstances do not allow of this, at least the seat of the inunction of the day previous can be washed with soap and water.

If the treatment by inunction is carried out with a due observance of all the precautionary rules which have been given, it can be kept up for months without the appearance of any symptoms of mercurialism. But different patients are very differently affected by it. While many show an extraordinary tolerance of mercurial inunctions, others, after a short time, manifest symptoms of slight stomatitis. Apart from other circumstances, the character of the skin is of great influence in this respect. I once had an opportunity of seeing this quite distinctly exemplified in entirely parallel cases in two young persons, one of whom was fat and had a white, tough skin, while that of the other, who was not so well provided with fat, was softer and more florid. The treatment was exactly the same in both cases, but its influence upon the existing induration was much more quickly seen in the case of the latter person, manifestly because his skin was better qualified to absorb the mercury which was rubbed upon it.

The skin of many persons is very sensitive to the influence of mercury, and it requires but a small quantity of the ointment to occasion eczematous or extensive erythematous eruptions (see page 136). It is not always necessary, under these conditions, to put a stop to the inunctions, a temporary intermission being sometimes all that is needed; and when they are again resumed with due precaution, there are no more evidences of cutaneous irritation.

If stomatitis occurs, the inunctions must be discontinued, and, while continuing the use of the chlorate of potassa and the mouth-wash, the gums should be brushed with a stronger astringent solution, or touched with nitrate of silver, care being taken to avoid the teeth, and to wash out the mouth afterwards with salt water.

This method of treatment is to be preferred above all others in all cases of syphilis in which the state of the digestive tract forbids the internal administration of mercury, and also in all cases in which it is desirable to obtain the action of mercury as speedily as possible, as when destruction of important organs, such as the eye, the brain, or the larynx, is threatened by the disease. It is contraindicated in the cases of those who have very sensitive skins, with a tendency to eczema or acne, who have a thick growth of hair upon their bodies, or who are suffering from a copious eruption, with exudation into the hair-follicles, or a tendency to the formation of pustules.

Another mode in which mercury is administered through the skin consists in fumigation with various preparations of the metal. This method, which dates from the time when syphilis was epidemic, has quite recently found a warm advocate in Henry Lee. Cataneus (1504)[1] employed the fumes of cinnabar in the treatment of syphilis, and the same treatment was used by various physicians of subsequent centuries, among the more recent of whom may be named de Blegny (1683) and Pearson (1786). In England, Henry Lee and Langston Parker have recently done much in the development of this method of treatment. According to Lee, calomel is the most suitable preparation of mercury for this purpose; he sublimes it by means of a simple apparatus, and the fumes which arise are employed for a partial or general fumigation of the patient.

The apparatus devised by Lee consists of an enclosed spirit-lamp, above which is a plate having a central depression to hold the calomel, and surrounded by a broad, deep groove filled with water, so that the fumes of the calomel are mingled with steam. To fumigate the whole person, the patient is stripped, and placed upon a stool over the lamp, and enveloped in a flannel mantle, so as to be thoroughly exposed to the vapors which rise. Lee advises that during each bath the patient should open the mantle about the neck two or three times, and thus inhale some of the vapor. After the bath the surface of the skin will be found to be covered with a fine white powder of calomel, which is not to be removed. It is, therefore, best to administer the fumigation in the evening, so that the patient can at once go to bed, either with or without the flannel mantle, and thus favor the continuance of the sweating which is already established. Each sitting should be of fifteen or twenty minutes' duration, and the amount of calomel used should not be more than fifteen grains—on an average about eight. It is well to so regulate the amount of alcohol in the lamp, that the flame will go out of itself when the water and calomel have been exhausted.

Lee recommends this treatment for all stages of syphilis, but thinks that it is especially advantageous in ulcerative affections of the tertiary stage, when the general condition does not allow of the internal administration of mercury, and the character of the skin forbids inunctions. In cases of early syphilis. Lee continues the fumigations for two or three months; indeed, until all symptoms have disappeared. He looks upon a very slight affection of the gums as an evidence of sufficient mercurial action, and thinks that it should not be pushed further.

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[1] Aphrod., I. p. 168.

The only preparation that is suitable for external administration in solution in baths is corrosive sublimate. This method of administration is very uncertain in its effects; for, especially in the case of adults, if there are no erosions or ulcerations, it is very problematical if the sublimate finds its way into the blood by absorption.[1] For small children, on the other hand, the careful use of baths containing sublimate is often of great advantage, especially when a pustular eruption is present. For an adult two and a half drachms of sublimate should be dissolved in each bath, in which the patient should pass an hour or an hour and a half; for a child's bath, of a half hour's duration, from thirty to sixty grains should be used, according to the age. Zeissl adds the sublimate to the bath in combination with sal ammoniac, preparing the solution with about two and a half drachms of corrosive sublimate, eighty grains of the muriate of ammonia, and three fluid ounces of distilled water.

For internal use, a great number of mercurial preparations have been tried, and more or less highly prized. Apart from the undeniable idiosyncrasies against certain preparations of mercury which patients possess, the rule should be, to make use of that one which can be continued for the greatest length of time without causing derangement of the digestive organs. This is more apt to be the case with such preparations as are only rendered capable of absorption in the stomach and intestines, than with such as are given in a form capable of immediate absorption. Among the former, metallic mercury, as contained in blue pill, in the pills of Sedillot, and in mercury with chalk, is deserving of the first mention. Blue mass will generally be borne in a dose of five grains daily, and is therefore a very suitable preparation for such cases as require a long-continued course of mercury. The same is true of mercury with chalk, which may be given in doses of from three to five grains, either alone or combined with a small quantity of opium or Dover's powder. This preparation, in doses of from one-sixth to one-third of a grain several times during the day, is especially serviceable in the treatment of hereditary syphilis. Sedillot's pills consist of mercurial ointment, soap, and marshmallow powder, and are given in the same way as blue pill. Lebert[1] and Zeissl[2] have also given mercurial ointment in the form of suppositories introduced into the rectum, each suppository containing from three-quarters of a grain to five grains of the ointment, with cacao butter.

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[1] Compare an instructive case in *Cazenave*, l. c., p. 615, in which thirty-three baths, a single bath finally containing an ounce of sublimate, were administered with no manifest effect.

The oxides of mercury, of which the red was the first preparation of mercury which was administered internally, are no longer used in this way.

Of the two chlorides, the bichloride, or corrosive sublimate, has, since the time of van Swieten, been highly prized in the treatment of syphilis. This preparation is at all events the one best fitted for absorption from the digestive tract without previously undergoing change, for all other preparations have to become converted into the bichloride before they are capable of absorption. Quite frequently, however, it gives rise to disturbance of the stomach. For this reason corrosive sublimate should not be given upon an empty stomach, but after meals, and, as it is probable that it is converted into an albuminate before absorption, v. Bärensprung has proposed to administer it in this form, mixing it with albumen. This method has not been widely adopted, since a portion of the bichloride is removed from the mixture by the process of filtration to which it has to be subjected.

Corrosive sublimate is best given in pill form or in alcoholic solution, the dose being from a twentieth to a tenth of a grain, and the quantity given daily from a sixth to a quarter of a grain. The pills can be made by using clay, or, as advised by Zeissl, starch, for the excipient. The famous liquor of van Swieten, which is still largely used in France, was made by dissolving a grain and a half of corrosive sublimate in three fluid ounces of corn whiskey, which can be replaced by any other strong spirit, such as rum or brandy. The dose of this solution is from one to two fluid ounces.

Two doses of corrosive sublimate daily are sufficient, and

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[1] Berl. klin. Wochenschrift, 1870, No. 14.

[2] L. c., p. 359.

Erratum.—Vol. III.

Page 290, second text line from bottom, 'the dose of this solution is from one to two fluid ounces.' *For* 'ounces' *read* 'drachms.'

ZIEMSSEN'S CYCLOPÆDIA OF MEDICINE.

these may be of equal amount, or the larger dose may be given after the evening meal, or in a cup of some mucilaginous drink. If small doses are employed, and the digestive organs are in a healthy condition, the use of this remedy can be kept up for a protracted period. I saw in one case eleven grains administered during two months, without the occurrence of any unpleasant symptoms. If the remedy ceases to produce perceptible results, the dose should be increased, great care, however, being observed.

Julius Müller,[1] founding his idea upon the fact observed by Lassaigne,[2] that chloride of sodium in a solution of corrosive sublimate prevented the precipitation of albumen by the sublimate, recommends a mixture containing the double chloride of mercury and sodium, with an excess of chloride of sodium, as a more suitable preparation for internal use than the simple corrosive chloride.

In recent years, principally on account of the warm recommendation of G. Lewin, the hypodermic use of this preparation has been attempted by some observers, by Hebra indeed as early as 1860. The distinguishing features of this method are the production of a speedy action upon syphilitic symptoms, which is frequently first manifested locally (see p. 276); the accuracy with which the dose can be measured; and, its cleanliness compared with the treatment by inunction. But the severe suffering which it occasions is scarcely counterbalanced by the short duration of the treatment, which is said to require on an average only four weeks; and moreover, this rapid disappearance of the external symptoms of syphilis is by no means equivalent to a cure of the disease itself; and according to Zeissl there is more apt to be an early recurrence of the manifestations when this treatment is employed than when others are chosen. Some observers frequently met with suppuration at the points at which the injections had been made; but this complication, except among patients having a predisposition to it, can usually be avoided by observing due precaution.

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[1] Berl. klin. Wochenschrift, 1871, No. 49.

[2] *R. Maly*, in Zeissl, l. c., p. 396.

The solution for hypodermic use should be made by dissolving a grain of corrosive sublimate in one hundred minims of glycerine and water, mixed in equal proportion; and of this from four to seven minims, containing respectively about the one twenty-fifth and one-thirteenth of a grain of the mercurial salt, should be injected hypodermically once daily. The solution recommended by Müller has also been advised for hypodermic use. Prümers[1] advises the hypodermic use of "ethyl-sublimate" in the quantity of one-thirteenth of a grain to each injection, and Staub,[2] that of the chloro-albuminate of mercury and soda. The most appropriate places for making these injections are the back and the sides of the thorax.

Calomel also has recently been administered by hypodermic injection. When suspended in glycerine and water, it can be readily injected; but it has to a greater degree even than corrosive sublimate the disadvantage of causing abscesses in the subcutaneous connective tissue. According to v. Sigmund, who thinks injections of calomel more efficacious than those containing the bichloride, the formation of abscesses can be avoided by the employment of small quantities of the mild chloride, as from three-quarters of a grain to a grain and a half.

Calomel is less appropriate for internal use, since it is apt to affect the digestive organs, and, when thus used, it is therefore usually given in combination with small doses of opium. If, however, the occurrence of some symptom of serious import, as, for instance, iritis, renders it desirable to induce a rapid mercurialization, the administration of calomel in conjunction with mercurial inunctions is the most ready way of attaining this end. Under such circumstances it is given several times daily in doses of two-fifths of a grain, with one-twelfth of a grain of opium, until evidences of slight salivation are produced.

The combinations of iodine and mercury are especially prized in France. Of these the milder or green iodide is a favorite with Ricord and his followers, and is frequently given by them during the entire treatment, extending over a period of many months. It is, indeed, a very active preparation, but causes in some individuals very unpleasant symptoms of disturbance of the digestive tract, such as colicky pains and purging, with blood-evacuations, even when given in doses not exceeding three-quarters of a grain twice a day in combination with opium. The addition of opium is necessary for the avoidance of such symptoms, even when the dose of the mercurial is a small one, but it should be stated that Biett and Cazenave[1] assert, from special investigations which they have made, that this narcotic interferes with the action of the protiodide of mercury, and on this account they give the preference to lactucarium. They order a pill mass consisting of eight grains of the green iodide of mercury and twenty-four of lactucarium, to be divided into twenty pills. Each pill contains therefore two-fifths of a grain of the mercurial preparation, and this, when given two or three times daily, constitutes an average dose. If the remedy is well borne, and if no action on the symptoms is effected, or if a cessation of such action occurs, the dose may be carefully increased to three-quarters of a grain, or even a grain.

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[1] *Prümers*, Quecksilberæthylchlorid. In.-Diss. Berlin, 1870. See Archiv f. Derm. u. Syph., B. III., 1871, p. 454.

[2] Traitem. de la Syph. par les inject. hypoderm de sublimé. Thèse de Paris. (*Lancereaux*, l. c., p. 550.)

The use of the yellow iodide in the treatment of hereditary syphilis, and especially of infantile syphilis, has been warmly advocated by R. Foerster,[2] the suggestion of its use having, however, been previously made by others. He gives a twelfth, or at most a quarter of a grain twice daily, in combination with powdered gum. The mercury with chalk is a preparation which is better borne, and one which less frequently gives rise to intestinal catarrh, which, as Foerster admits, is an unpleasant complication to which the administration of the iodide is apt to give rise.

The red, or biniodide of mercury, has much more irritating qualities than the protiodide. It is therefore scarcely ever given by itself, but may be employed in small amount, dissolved in a solution of the iodide of potassium. It is prescribed in the following formula, which is modelled after that of Gibert: red iodide of mercury, three-quarters of a grain; iodide of potassium, thirty-eight grains; distilled water, eighty minims; filter, and add a fluid ounce of syrup, and four fluid ounces of distilled water:—dose, a tablespoonful twice daily. Berkeley Hill gives at a single dose from a quarter to a third of a grain of the mercury, with from three to five grains of the potassium iodide, in solution in water. Corrosive sublimate also may be given in a solution of the iodide of potassium. In the mixture a reaction takes place, by which a certain amount of the biniodide of mercury is formed and held in solution by the excess of iodide of potassium.

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[1] *Cazenave*, l. c., p. 599.

[2] Deutsches Archiv f. klin. Med., B. II., 1867, p. 214.

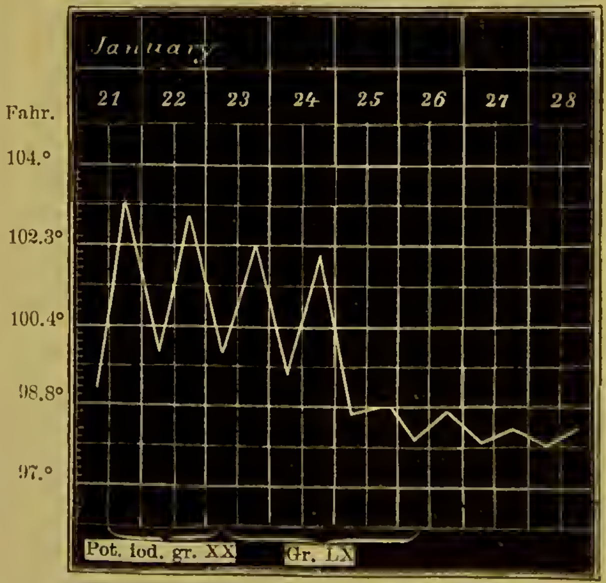
The iodides of mercury, and more particularly the biniodide, are especially recommended in the treatment of relapses of the cutaneous manifestations, in particular those of the squamous form, and also for recurrent papules of the palms of the hands, etc. In the treatment of tubercular eruptions also, and, when the condition of the digestive tract will allow of it, in that of tertiary symptoms, the combination of the red iodide of mercury with the iodide of potassium often seems to have a very favorable effect. Under these circumstances, however, the preparations of iodine alone have a similar influence.

Mercurial treatment is contraindicated in but few cases of syphilis, and chiefly when the disease is met with in patients who are already seriously affected by some other disease. The existence of chronic pulmonary affections, which is quite commonly regarded as one of the principal contraindications of this treatment, does not absolutely forbid the use of mercury. If the syphilitic symptoms are sufficiently urgent, a careful trial of the treatment by inunction may always be made. Cases of chronic kidney disease, with albuminuria, on the other hand, provided the albuminuria is not due to syphilis, as may be pretty clearly ascertained from the history, are not suitable for mercurial treatment, since the patients are often salivated after the administration of but a small quantity of mercury. In cases of this kind, even in an early stage of the disease, preference should be given to the preparations of iodine and to the various decoctions of the woods which are used in the treatment of syphilis.

Many physicians are reluctant to administer mercury to anæmic patients, even in the height of the secondary stage. But in very many cases this anæmic condition is directly due to the syphilis; it increases as the symptoms of syphilis become more developed, and improves with great rapidity under the administration of mercury, while treatment with ferruginous preparations produces no effect. Such is not the case when syphilis attacks a person who is already chlorotic or anæmic. In such cases it is proper to administer iron in some form until distinct manifestations of syphilis make their appearance. I have frequently, and, as it appeared to me, with good results, used quinine, and in some cases cod-liver oil, together with mercurial inunction, in the case of delicate persons or such as had been reduced by previous disease.

The existence of pregnancy offers no contraindication to the use of mercury, and least of all during the early months, for there is then some hope that abortion may be prevented, and that, in case the father is healthy, the child may escape contamination. However, the mercurial treatment of pregnant women must be conducted with due precaution; von Sigmund recommends it only up to the seventh month of pregnancy.

Of the preparations of iodine, the one that is most frequently employed is the iodide of potassium. It manifests its greatest activity when given to patients with affections of the bones, rheumatic symptoms, pustular eruptions, and serpiginous ulcers, or with dry tubercular affections of the skin. Even in the course of a few days it shows its effects in these cases, and if there are febrile symptoms present, provided they are due to the syphilis and not to some intercurrent disease, its influence upon them is made evident after



two or three days, as may be seen by a glance at the curve on the preceding page.

The symptoms in this case consisted of an impetiginous eruption, nodes at various points, more especially upon the frontal bone, severe headaches, with nocturnal exacerbations, which for weeks had interfered with the patient's rest, and had been but little benefited by the hypodermic administration of morphia. On the second night after beginning the use of the iodide of potassium the patient slept better, but he was not entirely free from pain until the night between the 24th and the 25th of the month. After eighty grains of the iodide had been administered, the fever, which had been present for a long time, completely vanished. The remaining symptoms slowly but steadily disappeared.

It is not necessary that the symptoms should be very late in the order of time to be benefited by the iodide of potassium. Even in the eruptive stage this remedy has a very striking influence when it is used in the treatment of pustular eruptions, rupia, and the like, and of ulcerations in the mouth, with rapid destruction of tissue. Fortunately cases of this kind are not of frequent occurrence, and for the most part the symptoms, for the alleviation of which the iodide of potassium can be employed with advantage, occur at a very late period after infection. In addition to the affections already enumerated; degenerating gummata of the subcutaneous and submucous tissues, and destructive ulcerations of the throat and larynx especially call for its administration.

In such cases the remedy is usually strikingly well borne, and only exceptionally occasions nasal catarrh or conjunctivitis; and I have never, under such circumstances, seen it cause the conditions to which the name Iodism has been given. One patient complained, while taking moderate doses (thirty grains a day), of intermittent symptoms of weakness, which, however, ceased upon the addition of the aromatic spirit of ammonia to the solution.

Several English physicians, and among them are Sir J. Paget and Hutchinson, advise that this remedy should always be given with the carbonate of ammonia or the aromatic spirit of ammonia, for they assert that it is better borne in this combination. Patients usually have a good appetite, and increase rapidly in weight while taking the iodide, unless the good effects of the drug are interfered with by keeping them upon too restricted a diet. Those patients who are usually in a more or less cachectic state should have as good and rich a diet as the condition of their digestive organs will permit.

The dose in which this remedy is usually given to patients who have not yet taken it, is from three to five grains three times daily ; in old cases, and to patients who have already used it for some time, or where symptoms are present which make it desirable to arrest an ulcerative process as speedily as possible, a larger dose, from eight to fifteen grains several times a day, must be given. Some cases are not affected by doses of this size, and under such circumstances larger quantities, even thirty or forty-five grains several times a day, must be given to attain a cure.[1] Iodide of potassium should always be taken in a large quantity of fluid, about half a tumblerful of water to each dose, and preferably after meals, so that its elimination may follow its absorption at a longer interval than would be the case were it taken into an empty stomach. This remedy may often be given in surprisingly large doses for a long time without causing any ill effects ; indeed there are some cases of tertiary syphilis in which this is almost a necessity, for only by its constant use can the tendency to ulceration be kept within bounds. I knew a woman who took the iodide in increasing doses, with but few interruptions, for a period of five years, and only while taking it did she enjoy good health. Whenever she stopped its use for any length of time, the serpiginous ulcerations from which she suffered, and which were almost healed, increased in size, and new ones made their appearance. It must be admitted, as a matter of regret, in regard to the striking results often obtained by the use of the iodide of potassium, that they are very frequently not lasting ; that when the remedy is not continued long enough after a complete cessation of all symptoms has been reached, a speedy recurrence of the manifestations is apt to take place. On account of this peculiarity of the remedy, it is important that, whenever possible, the smallest efficient dose should be given at the beginning of the treatment, so that if its use is to be long continued, it can be done without having to resort to unusually large quantities.

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[1] Compare also *Langston Parker*, Brit. Med. Journal, 1869, Vol. I. p. 466.

In the treatment of cerebral affections attended with convulsive attacks, such as epilepsy, chorea, and the like, Hughlings Jackson[1] advises the use of the iodide of potassium in combination with the bromide.

Sometimes the iodide of potassium will not be tolerated either alone or in combination; and under such circumstances the iodide of sodium, which does not occasion catarrh, or the iodide of ammonium[2] may be tried.

It frequently occurs, in cases in which it is advisable to use the iodide, that the presence of pronounced anæmia calls for the use of ferruginous preparations; and this is especially the case when the occurrence of albuminuria renders the existence of amyloid degeneration probable. In such cases it is better to order the iodide of potassium in combination with the ammonio-citrate of iron, rather than a preparation containing both iodine and iron, such as the syrup of the iodide of iron. I have convinced myself, as others have done, that the action of iodine obtained by the use of the syrup is not so manifest as that resulting from the use of a solution of the iodide of potassium containing a far smaller amount of iodine.

Instead of the iodine salts, the tincture of iodine, or what is better, the compound tincture,[3] may be given.

Although the iodide is so efficacious in the tertiary stage of syphilis, still, cases are met with in which a complete cure cannot be obtained even with increased doses, or in which a constant recurrence of the symptoms takes place whenever the treatment is suspended. In some cases of this character, a permanent cure may be finally obtained by the use of a tentative course of mercurial inunctions or calomel fumigations. Numerous cases have also been reported in which this result was obtained by treatment with the decoctions of woods.

There are several magisterial preparations used in this method of treatment, the one most often employed in Germany being the one known as Zittmann's decoction, while in Italy preference is given to that of Pollini.

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[1] Med. Times and Gazette, 1873, Vol. I., May 10.

[2] As to the iodides of sodium and ammonium, compare *Berkeley Hill*, Brit. Med. Journal, 1871, Vol. II. p. 725.

[3] Equivalent to the simple "Tincture of Iodine" of the British Ph.

The former contains a small quantity of mercury, and the German Pharmacopœia substitutes for it two decoctions of sarsaparilla, of different strengths, which contain a considerable amount of senna leaves, so as to be purgative in the doses usually employed. With remedies of this character, as with others, it is best not to follow any routine, but to adapt their administration to the condition of the patient. Since the main object of this treatment is to stimulate the secretions, the patient had better pass the greater part of the day in bed, so that the secretion of the perspiration may be kept up; in order to maintain the action of the kidneys and intestines, the decoction must be given in pretty large quantities. In the morning the patient should take from eight to sixteen fluid ounces of Zittmann's stronger decoction, and in the evening thirty-two fluid ounces of the milder preparation. These decoctions should be warmed before being administered, and their use should be continued until all symptoms have disappeared, which may not occur until after the expiration of four or five weeks. If the patient does not bear this treatment well, it must be modified or even suspended. The diet during this time must be nutritious, but there is often some difficulty in selecting appropriate food, since the use of such large amounts of these decoctions frequently causes a catarrh of the stomach.

During the secondary stage of syphilis decoctions of this kind may be administered as adjuvants to the treatment by inunction, and in the treatment of the tertiary stage, if the disease is advancing rapidly, their administration in conjunction with the iodide of potassium is often attended by the most happy effects.

Of the numerous other remedies to which anti-syphilitic virtues have been ascribed at various times, and which include gold, silver, and platinum, it is only necessary to refer to opium and nitric acid. In the treatment of patients who are very much reduced, and who suffer severely from painful ulcerations, opium in conjunction with the iodide of potassium is sometimes of value, and nitric acid, which was formerly largely administered by English physicians[1] in all stages of syphilis, has been recently advised in the treatment of amyloid degeneration of the liver, spleen, and other organs.

Various local manifestations of syphilis, although they disappear under constitutional treatment alone, are much more quickly removed when local applications are also made directly to them. There is the greatest inducement for local applications in the treatment of papular affections of the mucous membranes, which greatly annoy the patients by the pain to which they give rise and by their secretion. This is especially true with regard to condylomata about the anus and genitals. The use of Plenck's solution, which was formerly in high favor, often caused œdematous swelling, and was attended by much pain, especially when only the deposit which is formed in this combination was employed. No less active and much less painful is the use of an ointment containing calomel in the proportion of one part of calomel to eight of lard, or the very effective application of calomel in the form of a powder dusted over the surface of the condylomata, previously moistened with chlorine water, or with a solution of common salt, as advised by Zeissl. Cleanliness and the use of charpie moistened in a dilute solution of carbolic acid or in black wash often greatly promotes the absorption of moist papules. Hardy[2] uses aromatic vinegar with good results. Sometimes, especially when the condylomata are situated about the anus and cause much pain, the application of a dilute solution of nitrate of silver (from half a grain to a grain to the fluid ounce) several times daily, exerts a favorable influence, by temporarily covering the painful papules with a protecting coat.

The treatment of papular and ulcerative lesions in the mouth and throat often require great care. The avoidance of irritating food, frequent washing of the mouth, and gargling with mild astringent solutions, suffice only in cases of mild character.

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[1] Compare a letter from *J. Currie* to Dr. Beddoes in Currie's Med. Reports on the Effects of Water, etc., Vol. II. p. 46. London, 1805.

[2] *Cazenave*, l. c., p. 613.

When these affections are extensive and obstinate, the diseased points should be repeatedly touched with the mitigated stick of nitrate of silver, or with a solution of carbolic acid in alcohol, or with the tincture of iodine of a strength appropriate to the cases. When ulcerations are present, threatening the uvula, all nourishment should be taken in fluid form. Small painful erosions or papules on the tongue should be touched with nitrate of silver, or from time to time with the acid nitrate of mercury.

Smoking frequently causes a continuance of papules on the point of the tongue, or a recurrence of them after they have been once removed, and must therefore be forbidden such patients.

Affections of the nasal mucous membrane and of the other tissues of the nose may often be topically treated very advantageously. These affections are especially annoying to the patient when they are attended by an ill-smelling discharge (ozæna). A discharge of this character may be kept up by the presence of necrosed portions of bone in the nasal cavities after the syphilitic affection has run its course. If these can be discovered and removed, the suppuration will be remarkably diminished and shortened. In all such cases it is necessary to keep the cavities of the nose thoroughly cleaned by the use of nasal douches, containing some antiseptic substance, such as carbolic acid or permanganate of potassa. Zeissl very justly observes that such patients are often very unnecessarily subjected to an antisyphilitic treatment, since this is manifestly uncalled for if the morbid process is no longer active. It is not always easy to decide whether or not syphilis is still active in these cases; but from the history of the case, the use of the rhinoscope, and from the presence or absence of recent manifestations in other parts, data sufficient for a diagnosis can generally be obtained. If there is reason to suppose that the process is still active, if the bones are affected, the iodide of potassium should be administered; but in the early stages of syphilis, when it may be supposed that the necrosis is consequent upon ulceration of the mucous membrane, and when papules are met with on other portions of the mucous membrane, mercurial treatment will have an influence on the local affections of the nose. To aid this treatment, calomel may be directed to be snuffed up the nose; but it must not be forgotten that this may readily cause slight salivation—indeed Biett made use of the nasal mucous membrane for the application of calomel in a general mercurial course.

When affections of the skin are entirely isolated, the attempt may be made to remove them by local treatment alone. The application of mercurial plaster, or frequent inunctions of white precipitate ointment, or of the oleate of mercury, or hypodermic injections of calomel or corrosive sublimate into the centre of the affected portion of skin sometimes suffice. V. Sigmund recommends in the treatment of the very obstinate papular affection of the palms of the hands, the application of corrosive sublimate with collodion, using the following formula: Corrosive sublimate, thirty grains; collodion, three fluid drachms; castor-oil, twenty-three minims.

The oleate of mercury, which was first prepared and used by J. Marshall,[1] is an elegant preparation when compared with other mercurial salves, and has been applied by O. Martini,[2] of Dresden, in the inunction treatment, in place of the ordinary mercurial ointment, but was found by him to be less efficacious than the latter.

The treatment of serpiginous ulcers is often attended with difficulty. If the crusts which form are thin and superficial, and have but little secretion beneath them, it is best to allow them to remain, especially when they are extensive. If they are so situated as to be liable to be removed by friction or external injuries, it is well to cover them with some indifferent plaster, or, if they are of small extent, with mercurial plaster. Small, round ulcers, especially those in the face, which are due to the pustules of impetigo, or those resembling varicella, are best treated, when the crusts become loose, with black wash or with an ointment containing either red or white precipitate. Zeissl states that iodoform, which has been so extensively used of late, is very useful in the treatment of torpid ulcers, and Lancereaux,

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[1] Lancet, 1872, Vol. I., p. 711. It was first brought forward by Messrs. Hopkins & Williams, of London. Compare also Prof. *Hilger*, in the Proceedings of the Phys. Med. Society at Erlangen, H. 6, 1874, p. 108.

[2] Schmidt's Jahrb., B. 160, 1873, No. 10.

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that the same remedy is attended with good results in many cases of serpiginous ulceration.

Painful periosteal swellings do not, as a rule, demand any local treatment; but sometimes the tincture of iodine painted upon them moderates the suffering. The oleate of mercury, with the addition of morphia, may also be thus employed. This combination is also recommended to be rubbed into the skin over swollen joints. Ricord advises the use of flying blisters in the treatment of painful nodes. Syphilitic testicles should be enveloped in mercurial plaster, or the oleate of mercury should be rubbed into the scrotum.

In all cases of iritis a solution of atropia should be dropped into the eye, in conjunction with general mercurial treatment. If the inflammation is very severe, blood should be drawn from the temples, and the mercurial treatment should be more energetic, and pushed even to the production of slight salivation (see p. 292). The occurrence of choroiditis or retinitis is also an indication for prompt and vigorous mercurial treatment.

In addition to these, many active local affections, such as those of the larynx, the lachrymal passages, the eye, the genitals, or the rectum, may call for special local interference, which is often of surgical character, and which must be specially adapted to the case in question.

The treatment of hereditary syphilis, and especially of syphilis occurring during childhood, must be guided by the same principles that have already been given. In these cases also mercurial treatment plays the leading part; but the particular method of administration which is to be adopted will depend upon special circumstances. The treatment by inunction is very suitable when its use is not forbidden by the presence of a pustular eruption. The amount of mercurial ointment that should be used daily is about five grains. The frictions should be made upon various parts of the body in succession, and should be suspended on the slightest symptom of commencing eczema.

In the syphilis of very small children, as has been previously stated, baths containing corrosive sublimate may be used with advantage, and Monti, v. Sigmund, and others advise the use of the hypodermic method of administration.

Most frequently, however, mercury is given internally, either in the form of mercury with chalk, or calomel, or the green iodide, in doses varying from a sixth to a quarter of a grain twice or thrice daily, and, if purgation is caused, a small amount of opium, from the one one-hundred and thirtieth to the one-sixtieth of a grain, must be added to each dose. The internal use of mercury may be supplemented by causing the child to wear upon its breast or back a flannel compress smeared with mercurial ointment. If proper precautions are observed, and due regard paid to all complications which may arise, the internal administration of mercury may be kept up for months with the greatest advantage.

The attempt has been made to administer mercury to children through the milk either of the mother or of goats; but the quantity of the metal which passes into the milk is so minute that no result can be looked for from this mode of treatment.

The feeding of infants is a matter of much importance. Mothers who have had syphilis may be allowed to suckle their syphilitic children, if they are in other respects suited to perform this office. If a child which is apparently healthy is born of a woman who but a short time before has given evidences of syphilis, she should not be allowed to suckle it, for it is possible that the child may not be contaminated, unless it becomes infected from some lesion which develops upon the mother's nipple. Such a child should not, however, be given to a healthy wet nurse, since it is possible that syphilis may be simply latent in it, and may break forth during the first three months of its life. It is still less allowable to permit a child which shows signs of syphilis to be suckled by a healthy wet nurse, even when she is made acquainted with all the dangers and expresses her willingness to take the risk. The use of apparatus to prevent the child's mouth coming in contact with the nipple will most probably be soon neglected on account of its inconvenience, and the nurse consequently be infected. If a syphilitic child has to be artificially nourished, either cow's milk, or condensed milk, or some one or other of the various substitutes for mother's milk should be used.

In the treatment of infantile syphilis, the most scrupulous cleanliness and the regular use of baths should be enforced ; and all moist papules must be treated with some of the various applications suggested above.

When tertiary affections of the skin or bones, or interstitial keratitis are met with in older children, mercurial treatment will often be found of use; but its effects in such cases are by no means so striking as those produced by it in the earlier stages of hereditary or acquired syphilis. In most of these cases the preparations of iodine, and these more especially in combination with iron, cod-liver oil, and a general tonic treatment, country air, milk, a sojourn at the seaside, salt-water baths, etc., will be of service.

In various stages of syphilis the proper specific treatment of the disease may be much aided by completely removing the patient from his business and usual mode of life, and the same course will often be found of advantage at the conclusion of a prolonged course of treatment. For many patients who are much debilitated, a winter in a mild southern climate, or a residence of several weeks during the summer in the country, or at the seaside, will be found extremely beneficial. While symptoms of syphilis are still present, the effects of treatment will be much promoted by attention to these hygienic precautions.

It was formerly believed that waters containing sulphur exercised an influence upon syphilis in various ways ; in the first place, sulphur baths were thought to cause a retrocession of the manifestations, in addition to which, waters containing sulphur were supposed to act favorably by removing the excess of mercury which had been introduced into the organism ; and finally, it was asserted that sulphur baths had the property of awakening latent syphilis,[1] so that their use gave a means of testing the completeness of a supposed cure.

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[1] Compare, on this point, *A. Reumont*, Beitr. z. Path. u. Ther. d. constit. Syph. Erlangen, 1864, p. 11. Id., Ueber die Behandlung der constit. Syph. und der Quecksilberkrankheit an den Schwefelquellen. Berlin, 1874, p. 11 et seq.

Recently more and more doubt has been expressed in regard to the last-mentioned quality claimed for these baths, and patients are not now so willingly sent to Aix-la-Chapelle, Baden, or other sulphur baths, merely to obtain a diagnosis of the success of the treatment which they have undergone. In regard to the other good effects of sulphur baths in the treatment of syphilis, they are for the most part due to an increased activity of tissue metamorphosis, and can be obtained as readily from the use of warm vapor or hot-air baths. If, in spite of this, certain resorts at which there are sulphur springs, more especially Aix-la-Chapelle, have obtained a particular reputation for the treatment of syphilis, this is due to the completeness and comfort of the baths and other appurtenances, which aid in carrying out a treatment with iodine or mercury.

Some physicians are of the opinion that the internal and external use of waters containing sulphur, during a course of mercurial treatment, may prevent too active effects from the remedy by rendering inactive the excess of mercury which is administered. Güntz, therefore, advises that when mercurial treatment has been previously employed, the patient should, before commencing another course of it, prepare himself by the use of sulphur baths, and by drinking either water from Aix-la-Chapelle or Weilbach, or an artificially prepared sulphur water; and should also keep up the same treatment during the use of inunctions. The results attained at Aix seem to render it probable that this practice is of advantage; but it is very desirable that accurate observations should be made, so that this question may if possible be decided.

There have been great hopes that hydro-therapeutics would produce good results in the treatment of syphilis; but these hopes have not been wholly fulfilled. Mild cases of syphilis will end in recovery under this treatment, as they will under a purely expectant one; but the course of well-marked syphilitic manifestations is scarcely shortened by it. Although impossibilities must not be expected from this mode of treatment, it still deserves an important place in the treatment of syphilis in conjunction with, or at the expiration of, a specific course. Hydropathic treatment, when suitable to the strength of the patient, by exciting the general metamorphosis of tissue, and the activity of the skin, increases the action of mercurial ointments. The usual increase of appetite which attends this plan of treatment must be regarded as likely to produce a favorable effect upon the patient's general condition.

In the cases of patients who have been much reduced by syphilis, or who have undergone a protracted and severe mercurial course, hydropathic treatment, together with good food and pure air, usually acts very favorably.

SYPHILIZATION.

Auzias Turenne, De la Syphilisation, etc. Archives de Médec., 1851.—*Sperino*, La syphilisation étudiée comme méthode curative et comme moyen prophylactique, etc. Traduct. franç. Paris, 1856.—*W. Boeck*, Die Syphilisation bei Kindern. Christiania, 1856.—The same, Recherches sur la Syphilis. Christiania, 1862—*v. Sigmund*, Wien. med. Wochenschr., 1859, Nos. 17 and 19.—*v. Lindwurm*, Aerztl. Intell.-Blatt., 1860, No. 13.—*A. Holst*, Behrend's Syphilidolog., N. R., B. III., 1861, p. 394.—*W. Boeck*, Med. Times and Gazette, 1865, Vol. I., June 10.—*Lane* and *Gascoyen*, Med.-Chir. Transact., Vol. 50, 1867, p. 281.—*A. Oewre*, Archiv f. Derm. u. Syph., B. II., 1870, p. 1.

This method of treating syphilis was based upon experiments which were conducted by Auzias Turenne in 1844, and were by him laid before the Paris Academy of Medicine in 1850. He inoculated the secretion of ulcers which he regarded as syphilitic, first upon animals and afterwards upon men, and found that after the operation had been many times repeated, a state of immunity was finally caused, and inoculation was no longer possible. While Auzias Turenne concluded from these experiments that it would be possible in this way to render men insusceptible to syphilis without having undergone the disease in its constitutional form, others, and among them Sperino, of Turin, applied this method to the treatment of constitutional syphilis. Auzias Turenne gave to that state of the system in which inoculation was no longer possible the name of *syphilization*, and this term has since been adopted to express the method itself. The use to which it was proposed by Auzias Turenne to put syphilization may be called prophylactic, while its employment in the treatment of syphilis which already exists may be called "curative."

Prophylactic syphilization never found much favor, and the investigations made upon Dr. Lindemann, as well as others given above (page 45), furnish absolute proof that the inoculation of any amount of chancroidal virus will not blunt or protect the organism against the action of the syphilitic poison.

Curative syphilization is at present practised only in Norway. The method followed by W. Boeck, who is a warm advocate of this treatment, is as follows : Inoculations are made every third day upon various parts of the body—the chest, the upper arm, and the thigh—with secretions obtained from chancres, or from syphilitic ulcers which have been irritated by the application of savine powder or ointment. The pus which is used for subsequent inoculations is taken from the pustules already produced, and only when the secretion from this source is no longer capable of inoculation is recourse had to a fresh syphilitic sore, and this in turn is then kept up until these inoculations also fail to produce any result. The tolerance which the skin and organism manifest for inoculations of this character is often merely local, for while the operation fails if performed near the last pustule, it succeeds at a more remote locality, and it is also of temporary duration, for when some time has elapsed after immunity has been attained, inoculation is again possible (Danielssen's case, page 100).

From the standpoint which we have already taken, we cannot consistently call this proceeding "syphilization," for the inoculations are not done with syphilitic but with chancroidal virus, and on this account Faye has proposed the name "curative chancre-inoculation" for this mode of treatment.

It cannot be denied that cases of constitutional syphilis recover under this treatment, but their progress is tedious, and does not differ from that which is seen under a purely expectant treatment, or under what Hjort, Cullerier, and others tried as equivalent to chancre-inoculations, namely, the production of numerous small pustules on the skin by small blisters or the use of tartar emetic ointment. According to Boeck, however, syphilization only manifests its full effect when it has not been preceded by mercurial treatment.

A. Oewre, who took part in Boeck's observations for years, thinks that the action of syphilization is due to "derivation," and regards the whole method as an expectant treatment of syphilis. Recurrent attacks and tertiary manifestations are not prevented by this mode of treatment, and mothers treated by it bring syphilitic offspring into the world, as well as do those who have been treated in other ways.

This method, then, is not likely to obtain the confidence of physicians to any extent, and is as little likely to meet with the approbation of patients, for it is not only tedious, and causes, in comparison with mercurial treatment, but a very slow retrocession of the symptoms; but, moreover, it annoy sthe patients by the production of numerous ulcers, which are often painful and sometimes even phagedænic, and which leave indelible traces of their existence.

The employment of *vaccination* in a similar way (*i.e.*, by repeated inoculations) in the treatment of syphilis, has also been recommended;[1] but, outside of Russia, where the first experiments were made, it has not been extensively attempted.

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[1] *Behrend's* Syphilidologie, N. R., B. III., 1861.

INFECTION BY ANIMAL POISONS.

DISEASES OF ANIMALS.

BOLLINGER.

DISEASES OF ANIMALS.

Virchow, Infectionen durch contagiöse Thiergifte (Zoonosen). Handbuch der spec. Pathologie und Therapie. Red. von Virchow, B. II., 1 Abth. Erlangen, 1855.—*Reder* und *Korányi*, Zoonosen. Handbuch der allg. und spec. Chirurgie von Pitha und Billroth, I. B., 2 Abth. Erlangen, 1870.

Greve, Erfahrungen und Beobachtungen über die Krankheiten der Hausthiere im Vergleich mit den Krankheiten der Menschen. Oldenburg, 1818–1823.—*Levin, J.*, Vergleichende Darstellung der von den Hausthieren auf Menschen übertragbaren Krankheiten. Gekrönte Preisschrift. Berlin, 1839.—*Heusinger*, Recherches de Pathologie comparée, Vol. I. und II. Cassel, 1847.—*Veyssière*, Des maladies transmissibles des animaux à l'homme. Paris, 1853.—*Förster, A.* Hand. der spec. path. Anatomie, 2 Aufl. Leipzig, 1863.—*Schmidt, Max*, Zoologische Klinik. Handbuch der vergleich. Pathologie und path. Anatomie der Säugethiere und Vögel, B. I., 2 Abth. Berlin, 1872.—Compare also articles by *Hering*, *Ritter*, *Skrezcka*, *Waldeyer*, *Leisering*, and *Bollinger* in the Jahresberichte of Canstatt, Virchow, and Hirsch.

Laubender, Seuchengeschichte der landwirthschaftlichen Hausthiere. München und Burghausen, 1811.—*Kreutzer, J. M.*, Grundriss der gesammten Veterinärmedicin. Erlangen, 1853.—*Rychner, J. J.*, Specielle Pathologie und Therapie der nutzbarsten Hausthiere.—*Spinola, W. Th. J.*, Handbuch der spec. Pathologie und Therapie für Thierärzte. Berlin, 1858.—*Hering*, Pathologie und Therapie für Thierärzte, 3 Aufl. Stuttgart, 1858.—*Röll, M. F.*, Lehrbuch der Pathologie und Therapie der Hausthiere, 2 Bde., 3 Aufl. Wien, 1867.—*Bruckmüller, A.*, Lehrbuch der path. Zootomie der Hausthiere. Wien, 1869.—*Haubner, G. C.*, Handbuch der Veterinärpolizei. Dresden, 1869.—Derselbe, Landwirthschaftl. Thierheilkunde, 6 Aufl. Berlin, 1873.—*Gerlach, A. C.*, Handbuch der gerichtl. Thierheilkunde, 2 Aufl. Berlin, 1872.—*Bouley* et *Reynal*, Nouveau Dictionnaire pratique de médecine, de chirurgie et d'hygiène vétérinaires. Tom. I–IX., Paris, 1856–71.—*Hurtrel d'Arboval, L. H. J.* Dictionnaire de Médecine, de Chirurgie et d'hygiène vétérinaires. Edition entièrement refondue et augmentée par A. Zundel, T. I. Paris, 1874.

ALTHOUGH the actual number of diseases communicable from animals to man is by no means large, this class of affections may, nevertheless, justly be said to occupy a relatively important position in human pathology. Apart from the great severity that characterizes these animal diseases, several of which are, so far as our present knowledge extends, practically incurable, they present so many peculiar phenomena, especially as regards their origin and mode of communication, that their comparative study cannot be regarded as other than one of the most important pathological problems now awaiting a solution. It can be safely predicted that a persistent and methodical investigation of the etiology of the entire class of animal diseases will contribute materially to our knowledge of human pathology.

When we consider the list of diseases capable of being transmitted from animals to man, we cannot fail to be impressed with the fact, that in this respect the relation between the two species is much more intimate than is generally appreciated. In addition to the more important maladies to which our attention is most frequently attracted (*glanders*, *malignant pustule*, *hydrophobia*), it has been shown by numerous recent observations, that another less formidable affection, *foot and mouth disease*, not unfrequently gives rise in man to a specific disorder. The discovery of the communicability of *cow-pox* to man, for the knowledge of which we are indebted to Jenner, has proved one of the greatest boons ever conferred upon mankind through the medium of the medical profession. Another class of parasitic diseases (*trichina*, *tape-worm*) has likewise been shown to have its exclusive origin in our domestic animals. Numerous epizoa, moreover, of animal and vegetable origin, are communicable from animals to man, giving rise in the latter to specific morbid symptoms. Furthermore, observations made in experimental pathology have rendered it extremely probable that the tuberculosis to which cattle are subject may prove to be one of the sources of the tuberculosis that prevails in the human subject. Mention should be made, finally, of those diseases produced by the *specific physiological virus* of certain animals, reptiles, and insects (snake-poison, the poisonous sting of numerous insects), as well as by the implanting of septic poisons derived from animals. Whether future scientific investigations will reveal still other animal diseases dangerous to man, must for the present remain an open question.

If, on the other hand, the inquiry be put, what diseases are communicable from man to animals, we cannot fail to be impressed with the peculiar character of the reply. There are, indeed, a few parasitic diseases to the contraction and development of which the two species are equally susceptible, and also another class of diseases which have been transmitted experimentally from man to animals (*tuberculosis*, *syphilis*, *small-pox*, *septicæmia*). Certain animal diseases also have been communicated by retro-inoculation from man to animals. The exceptionable nature of these few instances, however, will enable us the better to appreciate that to the lower animals is granted in this respect a much greater immunity from contagion than to man. It is important at the outset to reject emphatically the theory, however much may have been advanced in its favor, that certain epidemic diseases (*e.g.*, *cholera*, *typhoid fever*) may occur in animals, especially our domestic animals. On the contrary, the results of all artificial attempts to implant these diseases in animals, hitherto reported, admit of an extremely varied interpretation. In view, then, of the above facts, we are justified in affirming that while man evinces a strong affinity for animal poisons, the susceptibility of animals to contagion of human origin is but slight.

NOTE TO THE AMERICAN EDITION.—It may be well to remark at this point, with the view of obviating any misunderstanding on the part of the reader, that in the following articles upon animal diseases communicable to the human subject, the nomenclature recently proposed by v. Pettenkofer (Zeitschrift für Biologie, IX. Band, p. 411, 1873) with reference to the *materies morbi* has been adhered to. This classification is here quoted in the words of the author:—

"It would perhaps conduce to a better understanding of the subject if we should strike out from our vocabulary the extensively employed and misused words *contagium* and *miasma*, which no longer retain their original signification, and should select in the place of these old, indefinite, and ambiguous terms, some new expressions better adapted to our present ideas. In accordance with the present status of our knowledge and theories upon this subject, the so-called contagia and miasmata are now to be considered as morbific agents which we have long been accustomed to comprehend under the general term of infecting virus. Syphilis, as well as intermittent fever, is contracted through the medium of a specific infecting principle, which makes its way into the economy, the essential points of distinction between the two affections consisting merely in the difference in their specific character, their mode of origin, and the laws which govern their communicability. Some of these morbid poisons, that of syphilis for instance, are developed and propagated only within the organism of the living and infected body; some, such as the malarial poisons, are developed and generated not within the infected individuals, but only in their immediate vicinity; while still others (possibly small-pox) grow and multiply in both ways.

"Both these categories of infecting principles would be, perhaps, more perfectly appreciated, if we were to adopt, instead of the terms contagium and miasma, some other expressions which would serve to embody the idea of the multiplication of the specific virus *within* or *without* the organism of the patient, a distinction which might be expressed by the words, derived from the Greek, *endogenous* (engendered within) and *exogenous* (engendered without). The exogenous infecting agents would again be divided into two sub-orders, or groups: first, those which are fixed in the locality where they originate, and are not transferable from one place to another by means of the inter-communication of human beings (as has hitherto been supposed to be the case with respect to malarial poisons); second, those of which the *materies morbi*, though having a local origin, are capable of being conveyed about in an active state by means of human intercourse, or which, to use the language hitherto employed, are "transportable." According to my own view and that of others, cholera, yellow and typhoid fevers are produced by the exogenous, transportable, infectious agents, whose vitality is manifested in any locality to which they may be conveyed by man, but which are only capable of reproducing themselves and spreading the disease outside the infected organism."

GLANDERS.

(MALLEUS HUMIDUS. MALIASMUS.)

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wandten Krankheiten. Leipzig, 1863.—*Roloff*, Die Rotzknoten in den Lungen. Magazin für die ges. Thierheilkunde, B. 30, p. 357, 1864.—*Gerlach, A. C.*, Die Rotzkrankheit. Jahresbericht der k. Thierarzneischule zu Hannover, I., 1868, p. 75; ibidem, II., 1869, p. 80.—*Waldenburg, L.*, Die Tuberkulose, die Lungenschwindsucht und Scrophulose, p. 186. Berlin, 1869.

Schilling, Rust's Magazin für die gesammte Heilkunde, B. XI. p. 480. Berlin, 1821. —*Rayer*, De la morve et du farcin chez l'homme. Paris, 1837.—*Tardieu*, De la morve et du farcin chron. Paris, 1843.—*Hauff, H.*, Die Rotzkrankeit beim Menschen. Stuttgart, 1855.—*Guerin, Tardieu, Bouley*, etc., Contagion de la morve du cheval à l'homme. Bull. de l'Acad. impériale de méd., T. XXVI., No. 19 sv., 1861.—*Rayer*, La question de la morve à l'académie. L'Union médicale, 10 Sept., 1861.—*Küttner*, Beitrag zur Frage über den Rotz beim Menschen. Virchow's Archiv f. Path. Anat., B. 39, p, 548, 1867. See also the works of *Virchow* (Die Zoonosen, Handbuch der spec. Path. und Therapie, B. II. 1. Erlangen, 1855), *v. Korányi* (Zoonosen, Handbuch der allg. und spec. Chirurgie, B. I. 2. Erlangen, 1870), die Jahresberichte *von B. Ritter, Hering, Leisering, Skreczka*, und *Bollinger*, in Canstatt's Jahresberichten und deren Fortsetzung von Virchow und Hirsch.

GLANDERS IN HORSES.

Historical Notice.

The first allusion to glanders is found in the literature of the fourth century, reference having been made to it under the name of *μάλις* and *malleus* by Apsyrtus, a veterinary surgeon in the army of Constantine the Great. Apsyrtus included, moreover, under this name, a number of very diverse dangerous maladies, while his description of farcy corresponds to the elephantiasis of the present time. Vegetius, in the fifth century, made a similar error in describing glanders.

For a long time before the communicability of glanders to man was recognized, the disease had acquired a certain interest as regards its bearings upon human pathology, from the circumstance that van Helmont (1682) sought to refer to it the origin of syphilis, a theory adopted at a later date by Ricord. The source of this erroneous idea has been traced by Virchow to the report, at one time accepted as true, that glanders first appeared, together with syphilis, at the siege of Naples, toward the end of the fifteenth century. More recent observations[1] have since demonstrated that the virus of syphilis, when introduced into horses, never produces glanders, and it is still more significant that syphilis as such is never known to occur in domestic animals.

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[1] *Semmer*, Oesterr. Vierteljahrschrift f. wiss. Veterinärkunde, B. XXXII. p. 110, 1869.

The principal points in the history of glanders to which the discussion has ever recurred are, in the first place, the question of *contagiousness*, which has given rise, especially in France, to long and obstinate disputes; and second, the mode of development of the disease.

The contagious character of glanders was indeed recognized at an early date by Soleysel (1664), Garsault (1741), and both writers named Lafosse (1754-1772)—the latter at least as regards certain forms—while the inoculability and fatal character of the malady were demonstrated by Abildgaard;[1] and finally the question of contagiousness was established by Viborg (1797), from accurately conducted experiments. In the face of all these facts, however, the non-contagiousness was again firmly maintained in France at the end of the last century, and this theory, manifestly tending to produce most detrimental results, was taught by Bourgelat and Chabert at the representative veterinary school at Alfort.

The experiments of Viborg were, it is true, confirmed at the beginning of the present century by Gohier and Huzard, yet it was only by slow and gradual steps that the non-contagionists yielded ground, admitting the contagiousness of the acute form of the disease, but denying the presence of this property in the chronic form which prevailed much more extensively. On this point of dispute the veterinary school at Lyons never failed to uphold firmly the theory of contagion as opposed to the doctrines of Alfort, and it was a representative of the former school, St. Cyr, who at a later date—about the middle of the present century—rendered signal service in disseminating throughout France correct views on this point. Barthelemy, it should be said, had previously (1849) entered a strong protest before the Paris Veterinary Society in favor of the theory of contagion. This delusion as to the non-communicability of glanders cost the government very dear, the yearly mortality from this disease among the French army horses reaching an enormous figure.

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[1] Der Pferde- und Vieharzt, 3 Ausgabe. Kopenhagen und Leipzig, 1795.

As to the nature of glanders, Dupuy (1817), regarded it as a form of tuberculosis, and on that ground was inclined to favor the theory of non-contagion. Other writers (Dittrich [1851], Baron, Philippe, Engel, Röll [I. Aufl.], and Falke) adopted the views of Dupuy, or else considered the disorders to be closely allied to (Spinola), or almost identical with (Villemin), tuberculosis; while a third class (Erdt and Ravitsch) attempted to establish a relation between glanders and scrofula.

The attempt was also made to connect glanders with diphtheria (Dittrich, Kreutzer, Röll), as well as with pyæmia (Ercolani, Bassi, Bruckmüller), but the investigations of Virchow (1855 and 1863) placed the question upon a new basis, and the theory advanced by him soon met with general acceptance. The pioneer researches of this pathologist resulted in assigning glanders to the class of "granulation tumors," and his views were soon confirmed by the brilliant researches of Leisering, in consequence of which the disputed question as to the nature of glanders entered upon a new epoch.

Finally, as regards the *pathogenesis* of glanders, a question of the utmost importance, the results of the experimental researches of Renault and Bouley (1840) seemed to support the belief at that time generally prevalent, that the disease might be developed *de novo*, as well as by inoculation; and when these investigators pretended that they had produced glanders in horses by the injection of simple pus, this served to render questionable the specific nature of the affection, tending to make it appear at most merely a form of pyæmia or septicæmia. The theory that glanders might be developed from a number of other diseases, such, for instance, as "Druse" (rhinitis), bronchial catarrh, inflammation of the lungs and lymphatic vessels, etc., —a theory that met with almost universal acceptance—received in this way additional support. Erdt claimed, furthermore, to have produced glanders by inoculations with scrofulous material, while Vines went so far as to claim similar results from the introduction of certain irritating substances (vitriol) into the windpipe, and even by injecting the blood of a rabid dog into the veins of a horse. After the theory of the spontaneous development of glanders—fortified, as it appeared, by clinical experience—had been constructed upon this basis, the attempt was next made to demonstrate anatomically (Ravitsch) that the nodules found in the lungs in glanders were embolic infarctions.

This, then, was the status of the theories which were current respecting glanders till within a recent date, when a few writers (especially Gerlach) began to vigorously oppose the idea of the autochthonous origin of the disease. We shall see, as we proceed, that additional arguments may be adduced in support of the views of this latter class, which serve to render the theory of development *de novo* extremely questionable, if not improbable.

Etiology.

Glanders in horses is a specific infectious disease, the spontaneous origin of which has not been demonstrated.

Glanders and farcy are perfectly identical affections, both equally contagious, and differing only in their local manifestations. Farcy is nothing but the cutaneous eruption incident to glanders, and is often only a secondary manifestation, bearing about the same relation to the other phenomena that the erythema and specific papules do to syphilis. The distinction between glanders and farcy, recognized by most authors, has its origin in certain clinical requirements, and is not founded upon any scientific mode of classification. We might, with as much propriety, designate the pulmonary phenomena of glanders as a separate affection.

The contagiousness of glanders is at present almost universally admitted to be one of the most clearly demonstrated facts in the pathology of animal diseases, and yet the successful production of an infection is dependent, in a measure, upon individual susceptibility, the extent of which must always be uncertain ; this factor is of less importance, however, than is commonly supposed.

Lamirault[1] placed 138 healthy horses among glandered animals, where all were fed together, groomed with the same instruments, and, furthermore, worked in the same harnesses. Of this number, twenty-nine only (twenty-one per cent.) became infected—twenty-eight with glanders, one with farcy. Of twenty-three horses in which direct attempts at inoculation were made, eight only, or thirty-five per cent., became infected. In like manner, Bagge and Tschering[1] having in five cases introduced the infectious material beneath the skin, succeeded in producing in but one case only any positive result.

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[1] *Hering*, Canstatt's Jahresbericht f. d. J. 1849, p. 35.

Observations have thus far failed to determine the exact mode in which the virus of glanders penetrates the system. It is believed that the virus having become attached to the mucous membrane, or the unabraded skin, sets up first at that point a local process, and thence forces its way subsequently into the remainder of the economy. It is a well-authenticated fact, that contagion is often produced by bringing in contact diseased and healthy animals, and, furthermore, by placing sound animals in stalls that have been previously occupied by those diseased.

Reasoning upon *a priori* grounds, and from analogy with similar morbid poisons, it seems, indeed, improbable that the virus of glanders can be introduced into the system through the unabraded cutaneous and mucous tissues, and the results of the experimental researches above alluded to serve only to increase these doubts. There are upon record, however, still further experiments, the results of which render it possible that the commonly received opinions upon this point are fallacious. If it were the fact that the virus of glanders is, as a rule, communicated by direct contact, we should naturally expect to find, on the one hand, a more frequent development of the cutaneous eruption, while, on the other hand, the mucous membrane in the immediate vicinity of the nostril would, with a certain degree of regularity, form the seat of tubercles and ulcers.

We have been instructed, however, by clinical as well as by anatomical observations, that the cutaneous phenomena of glanders seldom[2] make their appearance as a primary symptom, and, moreover, that the ulcers found in the mucous membrane of the nasal cavity are located, as a rule, in the upper portion of that cavity, extending thence downward toward the orifice. And if we assume the existence of an abrasion of the skin or mucous membrane to be essential to the introduction of the infecting principle into the economy, we are again met by the fact that the portion of the nasal cavity the least protected, and for that reason the most frequently exposed to injuries, is in reality the part that in exceptional cases only forms the seat of ulcers. It will be found, moreover, that the specific nodules and ulcers indicate no preference for those points that are shown by experience to be the most common seat of abrasions, cracks, and excoriations.

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[1] *Hering*, Ibid. f. d., Jahr., 1859, p. 24.

[2] There occurs upon the average one case of the specific cutaneous eruption in every ten cases of glanders.

In denying, then, the correctness of the prevalent belief, that the mucous tissues of the nose form the usual point of entrance of the infecting principle of glanders, we are almost of necessity forced by these reflections to admit the possibility of the *absorption of the virus together with the inspired air*, and in many instances, also with the food. Inasmuch as the lungs, the trachea, the larynx, and the upper portions of the nasal cavity are known to form the usual seat of the primary lesions, we are justified in concluding, that in a large proportion—possibly a majority—of all cases of glanders, a *volatile infecting virus*[1] has found its way into the economy, together with the inhaled air, producing either a primary blood-poisoning with secondary specific phenomena in the parts above described, or primary nodules and ulcers in the lungs, followed subsequently by the symptoms of general poisoning. The mucous membrane of the nose may, indeed, be primarily infected, when that part happens to be the seat of a wound or erosion.

This volatile property of the virus of glanders, which has thus far been either imperfectly appreciated, or not at all recognized, was first demonstrated about the end of the last century, through the brilliant researches of Viborg, whose observations were at a more recent date confirmed by Gerlach.

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[1] It may as well be distinctly stated here, that by the term volatile infectious matter, it is by no means intended to convey the idea of a gaseous substance. The agent may, however, be of a corpuscular character, and so light as to be capable of being caught up by the air and carried for a considerable distance.

Viborg (Viborg's Sammlung, II. p. 347) succeeded in producing glanders in a number of horses by inoculating them with the condensed exhalations and sweat of glandered horses. Similar results were attained by Gerlach (Jahresbericht f. 1868, p. 117). The negative results of the experiments of Hertwig and Regnault (Gaz. des Hôpitaux, 1861), by whom the noses of healthy and glandered horses were kept in contact by means of a leather band, are to be attributed to the inferior degree of susceptibility of the animals upon which the experiments were tried; and they argue just as little against the volatile nature of the virus, as, for example, do the negative results obtained by J. White[1] against direct infection. White inserted a piece of linen, saturated with pus from a diseased animal, within the nostril of a horse, and allowed it to remain there for a considerable length of time without communicating the disease.

The recognition of the volatile character of the virus of glanders tends to strengthen materially the theory of its spontaneous origin. Upon this question some light is thrown, first, by those cases in which the contagion proceeds from animals exhibiting neither a discharge from the nasal cavity nor cutaneous symptoms, but suffering rather from the specific pulmonary phenomena, and second, by those instances in which the latent, or quiescent form of the disease is developed in healthy animals, which having had the poison implanted in their system, present, externally, the picture of perfect health, and only after a considerable interval, extending it may be to months, begin to manifest the specific affections of the nose, skin, and glands. These last cases then are commonly reported and cited as affording satisfactory evidence of the origin *de novo* of glanders.

It not unfrequently happens that a post-mortem examination reveals the fact that the ulcers of the nose and the affections of the cutaneous surface are absent; but that, on the other hand, the larynx, bronchi, and lungs form the seat of specific ulcers and nodules. This phenomenon can only be explained upon the hypothesis that contagion took place through the medium of some *volatile* poison, or else that the primary alterations in the external parts of the body had healed, while the secondary phenomena only remained.

Experimental evidence of the correctness of this view is likewise afforded by the circumstance that in the case also of other animals which evince an affinity for the poison of glanders, the nose forms the favorite seat for the specific local manifestations, in whatever way the poison may have found its way into the body.

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[1] Compendium of Veterinary Art.

On March 28th, 1873, I inoculated the ear of a rabbit with fresh infected pus taken from the nose of a horse. The animal died in about three months. The autopsy showed the presence of specific uclers upon the ear, with partial disorganization of the cartilage; inflammation of the corresponding lymphatic vessels; specific nodules of the frontal bone and sinuses, and finally, tubercles and ulcers of the mucous membrane of the nasal cavity. On November 21st, 1873, I inoculated a goat with the puriform secretion formed upon an ulcer in the nose of a horse, the virus being implanted by injecting the substance, diluted with water, into the abdominal cavity. At the expiration of seven weeks there were produced in the animal specific ulcers of the nose, accompanied by a profuse purulent discharge from that organ, lymphangitis of the corresponding lymphatic vessels, and lymphadenitis of the laryngeal glands, forming, in a word, the typical clinical picture of acute glanders. There were found also at the autopsy numerous specific nodules in the peritoneum, spleen, lungs, and various muscles.

It has also been determined that the virus of glanders, in the form of a *fixed infectious material*, may be found not only in the specific products of disease (the secretion from the nose, the solid and fluid contents of the nodules and ulcers), but also in the *blood*[1] (Viborg, Coleman, Hering, Chauveau), and in the *secretions* and *excretions of the diseased body*, for example, the tears, saliva, sweat, urine, and milk.

The *communication of the morbid poison by means of external media*, especially the harness, has been frequently observed. Some cases are also known in which the disease was communicated by the *act of coitus*, by *suckling*, by *hereditary transmission*, and finally, by the *absorption of the poison together with the food.* The nasal discharge, when taken into the stomach with the food, appears, however, to be less capable of producing infection than are the exhalations from the lungs (Gerlach).

All varieties of glanders, both acute and chronic, are in an equal degree infectious, although the infectious properties of the acute form are regarded by many as the stronger. If a horse affected with the chronic form of glanders be inoculated with pus taken from another horse suffering with the acute form, the result is negative (St. Cyr); this serves to demonstrate the unity of the various forms of glanders, which in reality are only different manifestations of the same morbid process.

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[1] It is also true, however, that attempts to inoculate the disease by means of the blood are in many instances unsuccessful (*Hering*, *Gerlach*). I once injected beneath the skin of a rabbit several grammes of fresh, warm blood, taken from a glandered horse that had been just killed. The rabbit remained perfectly unaffected.

We come now to consider the question of the *spontaneous development of glanders*, a point that, as we have already remarked, has not yet been absolutely proved. While the authorities of all countries admit the possibility of this mode of development, it has been denied by Gerlach alone. Some writers go so far even as to regard glanders as a form of pyæmia, and consequently look upon the nodules found in the lungs as embolic infarctions. The non-contagionists, whose theories are now, fortunately, completely exploded, held it to be an established fact that glanders might be produced by all imaginable causes, for example, by excessive exertion, colds, impure air, deteriorated food, overwork, injuries, long-continued general debility, the sudden checking of the action of the cutaneous sweat-glands, catarrh, inflammation of the lungs, influenza, and the so-called "Druse" (rhinitis). The contagionists, while they admit the spontaneous origin of the disease as a phenomenon of rare occurrence, are by no means disposed to consider this as the common mode of its development. The difficulty of obtaining sufficient evidence as to the mode of infection, especially when we consider the chronic course of the latent variety of the disease, renders it obviously impossible to trace in each individual case the spontaneous origin of the disease, and it must therefore be admitted that the entire theory of spontaneous development is based merely upon the results of a few experimental researches of very questionable value.

The most significant experiments bearing upon this point are as follows: Renault and Bouley[1] injected into the veins of a horse, selected for the purpose of experiment, healthy pus obtained from an issue that had been established in another sound animal. Upon the sixth subsequent day there were developed upon the nose specific pustules that were soon followed by ulcers. Death resulted at the expiration of eight days. The autopsy showed numerous nodules in the lungs, with tubercles and ulcers on the lining membrane of the nose. The retro-inoculation of another horse, by means of the nasal discharge of this animal, was followed by a positive result. Laisné [1] claimed to have implanted glanders by the introduction of healthy pus into the nasal cavity. Erdt,[2] who regarded glanders as a form of scrofula, inoculated horses with scrofulous matter taken from the human subject, and asserted that he had in this manner produced glanders. Vines (loc. cit.) went still further, alleging that he had seen glanders induced in mules and asses by various irritating substances, for instance, by the injection of vitriol into the trachea, and by the introduction of the blood of a rabid dog.

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[1] Recueil de méd. vét., Vol. XVII., p. 257, 1840.

In estimating the true value of experiments of this nature, it is important to bear in mind that they all date from a period when pathological anatomy, as a science, was in a primitive state ; furthermore, that only a single instance of retro-inoculation is reported ; and finally, that in cases of pyæmia produced by embolism, structural changes are frequently seen, especially in the lungs, very similar to those occurring in genuine glanders. It will thus be understood how Hering,[3] having injected pus into the circulation, in the case of horses, saw produced a series of morbid changes that bore a strong resemblance to the lesions of glanders. Furthermore, observers of even limited experience are familiar with the fact that in the internal organs of old horses, and especially in the lungs, peculiar tubercles and circumscribed inflamed spots often occur that can easily be confounded with the lesions of glanders. All assertions like that, for instance, made by Erdt, that there have been developed in the lungs within sixteen days after inoculation tumors of the size of an egg, and in part affected with amyloid degeneration, can hardly be brought into harmony with general pathological experience.

On the other hand, there might be quoted a series of experiments, likewise made upon horses, in which different forms of purulent and ichorous matter were introduced into the organism, producing, it is true, purulent deposits in the lungs, septicæmia and pyæmia, but in no instance glanders.

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[1] La clinique vétérinaire, T. IV., p. 463, 1864.

[2] Die Rotzdyskrasie, etc. Leipzig, 1863.—The experiments of *Erdt* were made in the years 1834 and 1835.

[3] Ueber die Entwickelung der Rotzkrankheit. Repertorium für Thierheilk., 1871. p. 10.

In this connection may be mentioned the experiments of Leuret,[1] who injected putrid ichorous matter directly into the veins, and also into the subcutaneous cellular tissue of horses. In this manner he obtained, it is true, the appearances produced by putrid infection; but nowhere does he make any allusion to alterations at all characteristic of glanders. Billroth[2] refers to a similar experiment upon a horse, that was not followed by any symptom of glanders. Günther[3] and Spinola[4] made injections of pus in horses without producing glanders. Gamgee[5] reports a case of thrombosis of the vessels of the lungs, with abscesses of these organs, occurring in a horse after the injection of pus into the jugular vein. Similar negative results were obtained by Lee.[6] Finally Waldenburg,[7] in conjunction with Köhne, inoculated several horses with tubercular, phthisical, and purulent substances, without causing in a single instance the development of glanders.

The experimental proof, then, of the development of glanders from purulent processes is indeed meagre, and the clinical observations which appear to lend support to this idea of the generation of the disease are offset by several facts in the history of glanders, which make it evident that an imperfect familiarity with the mode of development of the affection forms the basis upon which the theory of spontaneous development has been constructed. These phenomena, to which too little importance has been assigned, are, first, the *long period of incubation* of chronic glanders; second, the fact—of more frequent occurrence than is commonly supposed—that the primary lesions are frequently located in the lungs, bronchi, and larynx.

Apart from my own experimental researches above related, which show most clearly that, where glanders is inoculated (in rabbits and goats for instance), the discharge from the nose and other nasal symptoms generally make their appearance as the final phenomena, there may be found also in the history of glanders, as it occurs in the human subject (Küttner), numerous instances in which the nasal lesions were developed only after the chronic affection had already existed for a considerable period.

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[1] Archives générales de Méd., T. XI., p. 98, 1826.

[2] Allg. chir. Pathologie und Therapie, 5 Aufl., p. 97, 1871.

[3] Rust's Magazin für die ges. Heilkunde, Vol. XXX., 1841.

[4] Handbuch der spec. Path. u. Ther., B. II., p. 1690, 1858.

[5] *Hering* in Canstatt's Jahresbericht f. 1855, p. 13.

[6] *Hering* in Canstatt's Jahresbericht f. d. Jahr., 1854, p. 14.

[7] Die Tuberculose, die Lungenschwindsucht, etc., p. 540. Berlin, 1869.

It is a fact, more generally noticed, that glanders may be communicated by horses which have not evinced any symptoms of the malady; in which case the trouble was called by the old writers (Viborg and others) concealed glanders. Hering, Loloff, (loc. cit.) and Gerlach affirm that the lesion of the lungs may exist for a considerable length of time without being accompanied by any trace of nasal symptoms. Jessen[1] succeeded in producing glanders, by transferring some of the substance of a specific nodule from the lung of a horse in which this was the only lesion found. Similar views are held by Goubaux,[2] who alleges that in horses the alterations peculiar to that disease may be confined to the lungs and spleen. Bagge[3] found, upon examining 107 horses of a Danish regiment that were killed within a period of three years, in consequence of being glandered, or having suspicious symptoms, that in the case of 10 there were decided structural changes (ulcers of the nasal cavity); in 13 the alterations were moderately pronounced; in 53 there were merely nodules in the lungs, and a few ulcers of the air-passages (this number were to all appearances healthy during life); and finally, in 33 animals no lesions whatever were found.

In view of all this evidence, it may be laid down as a settled fact that our notions respecting glanders have hitherto been formed too exclusively from the contemplation of the clinical features of the disease, that is, from the affections of the skin and nose appreciable during life, whereas equal significance, at least, ought to be attached to the lesions of the lungs that are almost invariably coexistent, and, furthermore, to the structural changes in the trachea and larynx, that are not unfrequently encountered in carefully conducted autopsies.

An equally important cardinal point, it would appear, but at the same time one to which comparatively little value is assigned, is the circumstance that *the lesions of the lungs constitute quite as often the primary symptoms*, in chronological sequence, as do the changes in the nose and skin. In the light of our present anatomical and pathological experience, I am compelled to deny, then, the correctness of the theory entertained by Virchow and others, that the mucous membrane of the nose forms the point of entrance of the virus into the system in as large a proportion of cases as do the genital organs in the case of syphilis. I should in like manner dissent from the opinion of

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[1] Thierärztl. Mittheilungen, 1868, p. 14.

[2] *Hering* in Canstatt's Jahresbericht f. d. Jahr 1859, p. 24.

[3] Ibidem f. d. J. 1863, p. 25.

Virchow (loc. cit., p. 550) that the lesions of the lungs form, as a rule, the final phenomena of the disease.

To illustrate more clearly my views upon this point I will quote as evidence abstracts from some post-mortem examinations :

1. A horse was taken down with swelling of the right hind foot; a moderate mucous discharge from the nose was observed; at times cough and fever. As the swelling increased in severity, the fever likewise became more intense, and emaciation increased. The animal was therefore destroyed as incurable.

Autopsy, 30th October, 1871: *Subacute glanders of the larynx, air-passages, and lungs. Nasal cavity quite intact.* In the larynx extensive ulceration, with partial destruction of the vocal cords and the greater part of the mucous membrane of the larynx; necrosis of the arytenoid cartilage. On the upper part of the air-passage numerous characteristic ulcers. Several tubercles and nodules in the lungs, varying in size from a hemp-seed to a walnut, the central portions of which were partly broken down. Inflammation of the lymphatic glands and vessels of the right hind foot. Mucous membrane of the nose and adjacent cavities quite unaffected.

2. A nine-year old horse, well nourished, was led into the clinique, with symptoms of great dyspnœa. The animal presented a nasal discharge from the nostril of each side; moderately high fever; respiration and pulse accelerated; temperature, 104° F.; had a weak, painful cough. The opinion was formed that there existed in the larnyx some obstacle to respiration (œdema of the glottis or muscular paralysis), and tracheotomy was resorted to, which was followed by an amelioration of the symptoms. The animal was killed upon the eighth day after coming under treatment.

Autopsy, March 27th, 1872: *Chronic and subacute glanders of the larynx, acute glanders of the nose, air-passages, and lungs.* Upon the right and lower side of the septum nasi, an ulcer of recent formation was found, in the vicinity of which, above and below, were several similar though smaller ulcers. Well-marked swelling of the retro-pharyngeal and laryngeal glands, which organs were studded with specific tubercles. Excessive œdema of the glottis. The entire inner surface of the larynx transformed into one large specific ulcer that was partially covered with granulations. The arytenoid cartilage denuded for the most part on both sides, and necrosed. Confluent miliary tubercles in anterior edge of left lung.

3. Autopsy, March 28th, 1873: *Chronic glanders of the larynx and lungs; acute glanders of the nose, with swelling of the laryngeal glands.* Upon the right side of the septum nasi, small, recently formed ulcers, with a few tubercles in the immediate vicinity; similar appearances also upon the right conchæ. Considerable enlargement of the laryngeal glands upon the right side. In the larynx, at a point corresponding to the inner surface of the left arytenoid cartilage, a funnel-shaped ulcer, about four-fifths of an inch in diameter, whose base was formed by the exposed necrosed cartilage. At a corresponding point on the right side was a stellated cica-

trix, while a segment of the cartilage was wanting. In the lungs, tubercles and nodules, varying in size from a hemp-seed to a walnut, composed in part of firm cicatricial tissue, at points caseous and calcified.

NATURE OF THE MORBID POISON OF GLANDERS.

The question as to the nature of the infectious principle in glanders, as well as in other infectious diseases, still remains to be solved.

The discovery of the presence of a parasitic growth in the nasal discharge of glandered horses was long since made (B. Langenbeck). This parasite, known as puccinia, proceeds from the fodder, and may be detected in almost every nasal secretion. More recently, still lower parasitic organisms—bacteria—have been described by different authors as found in both horses and men when affected with glanders, and believed to be intimately connected with the *materies morbi.* The researches of Christot and Kiéner, Hallier,[2] Zürn,[3] Rindfleisch,[4] and others, all relate to this point, some of these writers describing the parasite as existing in the blood, others finding it in the pus of the ulcers and abscesses.

I have already stated in another work,[5] that having examined most carefully the fresh nodules found in glanders, and the fresh blood of horses suffering from this disease, I have never been able to verify the assertions of these writers. The virus of glanders induces a catalytic action, as has already been demonstrated by Franck,[6] similar in this respect to the infecting principle of syphilis and small-pox (Schönbein), resolving peroxide of hydrogen into water and oxygen.

The poison of glanders is fixed and volatile. It adheres first of all to the specific products of the disease, the solid and fluid portions of the nodules and ulcers in every stage of their devel-

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[1] Comptes rendus, LXVII., No. 21, p. 1054, 1868.

[2] Bayer. Aertzl. Intelligenzblatt, 1868, No. 25.

[3] Zoopathol. Untersuchungen, 1872, p. 36.

[4] Lehrbuch der pathol. Gewebelehre, 2 Aufl., p. 204, 1871.

[5] Beiträge zur vergleich. Pathol., II., p. 143. 1872.

[6] Thierärztliche Mittheilungen der Münchener Thierarzneischule, Heft XIV., p. XI., 1867.

opment, also to the blood, the secretions, and probably to all the tissues of the diseased animal that are permeated by the blood or other fluids. *The volatile infecting principle* differs essentially in its mode of action from that of various other infectious diseases, attaching itself for the most part to the exhalations and sweat of the diseased animals. According to the researches of Chauveau,[1] with regard to the diffusibility of the virus of glanders, the *materies morbi* is contained not in the serum but exclusively in the organized bodies (pus and other corpuscular elements) suspended in the animal fluids. This hypothesis does not conflict with the volatile character of the poison, and will be found, moreover, to harmonize with the known phenomena of other morbid poisons. Upon the other hand, the chemical property of this virus is held (Virchow) to be the more important, being regarded as acrid and irritating.

The virus of glanders manifests a pretty strong tenacity for life; for although in a dried condition its activity is frequently diminished (Viborg), it is often found to be effective after having remained for many months in stalls. If exposed in water to a temperature of 133° F., it loses its virulence (Viborg, Hofacker, Renault), and the same effect is produced by a number of chemical agents (disinfectants), such as chlorine, carbolic acid, etc. Its activity is said to be destroyed by decomposition (Gerlach). While it loses its virulent property when taken into the digestive canal of man (Decroix), dogs, swine, and fowls (Renault),[2] in the case of horses its activity is impaired, but not destroyed.

Probably no special conditions are required for the spread of the poison by intermediate vehicles, such as harnesses and other objects that are saturated with the virus. It belongs to that class of morbid poisons which are only multiplied within the infected body (entogenous).

The diffusion of the virus within the organism itself is produced partly through the agency of the blood-vessels, lymphatics, and serous canaliculi; partly also through the medium of the inspired air—for instance, from the nose to the larynx, bronchi, and lungs, or *vice versâ*.

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[1] Recueil de méd. vétér., 1861, p. 161.

[2] Recueil de méd. vétér., 1851, p. 873.

COMMUNICABILITY TO OTHER ANIMALS.

Glanders prevails not only in horses, but frequently occurs also in other animals belonging to the same general species (asses and mules), and is also communicable to man and the entire class of domestic animals, with the exception of cattle.

Sheep are especially susceptible to the poison of glanders (Gerlach reports a case which ended fatally in fifteen days), as are also *goats* (Ercolani observed a case of spontaneous infection in a stall in which infected horses were kept). Wirth saw a case of infection by inoculation ending fatally in twenty-one days; I myself witnessed a well-marked case of glanders in a goat developed in seven weeks after the peritoneum had been inoculated. As regards *dogs*, which manifest on the whole only a slight affinity for this virus, there results after inoculation a local infection (Gerlach, Delarbeyrette, Decroix); Nordström observed spontaneous infection in the case of a dog that had eaten infected meat. In the *cat*, glanders may be produced by inoculation (Christot and Kiéner); also by the consumption of infected meat (Gerlach); to which latter mode of infection *prairie dogs*, *polar bears* (Leisering), and *lions* (Leisering, de Silvestri) are susceptible; *rabbits* may become diseased either by being kept in an infected stall (Rivolta) or by inoculation[1] (Schilling, Colon, O. Wyss, Bollinger). Finally, *guinea-pigs* (Christot and Kiéner) and *mice* (Ercolani and Bassi) are susceptible to glanders. Gerlach has produced in *swine*, eight months after inoculation, a morbid growth similar to that which occurs in the lungs of the horse; but in no case were these local lesions accompanied by general constitutional symptoms. Spinola, on the other hand, has observed cases of glanders occurring in swine.

Glanders may likewise be produced in horses by retro-inoculations, either from animals in which the disease has been implanted in the manner above described, or from the human subject.

DISTRIBUTION AND FREQUENCY OF GLANDERS.

Glanders appears to occur among horses in all localities where these animals are found, while its dissemination and frequency in the different countries of Europe depend chiefly upon the sanitary measures adopted by local authorities. In cold climates (*e.g.*, Sweden) it prevails as extensively as in hot regions (Algiers, Tunis, Tangiers); in Java it is of common occurrence.

Dupuy (compare Vines) erroneously supposed glanders to be unknown in hot climates. In countries where there exist properly qualified medical boards, and efficient sanitary regulations capable of dealing with the infectious diseases of animals, the animal mortality from glanders is comparatively small. Hahn [1] calculates from statistics kept for a period of nine years, that 175 horses are annually destroyed in Bavaria by glanders (equivalent to four per cent., estimating the entire number of horses in that country at about 400,000). Up to the middle of the present century glanders raged in the French army to such an extent that when the rate of annual mortality amounted to 75 in a thousand, 35 of these deaths resulted from this disease. Not until the idea of curing the disease was abandoned, and its contagiousness was gradually recognized, did the total mortality fall from 75 to 44.5 in a thousand, and the number of those affected with glanders from 35 to 20.2 in a thousand (Castelnau).[2]

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[1] *Gerlach* inoculated rabbits with uniformly negative results.

Glanders prevailed in France in the form of an epizootic in 1776, 1807, and 1808 (Erdt, p. 61). At Mezöhögyes, in Hungary, in one of the largest studs in Europe, glanders raged in the form of an epizootic from the year 1808 to 1816, to such an extent as to cause the death of nearly 20,000 horses. In the year 1812 alone, as many as 12,000 were killed in consequence of being glandered. This immense loss is to be attributed to the fact that the contagious nature of the disease was not suspected

PATHOLOGICAL ANATOMY.

Glanders is characterized anatomically by the formation of neoplastic growths which appear either in the form of circumscribed tubercles developed in parts for which they have a peculiar affinity, or else as diffused infiltrations in certain organs. The nodules of glanders and farcy were formerly regarded as the result of deposits or exudations from the blood, and Virchow was the first (1854) to demonstrate that these lesions were of neoplastic origin. These conclusions, which his later work upon tumors established upon a broader basis, were fully confirmed by the researches of Leisering, Förster, and others.

The neoplastic growths of glanders are characterized by a great tendency to disintegration, as well as to the formation of ulcers and abscesses, and are located in the mucous membrane of the organs of respiration (nose, larynx, bronchi), in the lungs, in the skin and subcutaneous cellular tissue, and less frequently in the other internal organs (liver, spleen, kidneys). A characteristic sign in the case of horses is the symmetrical manner in which the corresponding lymphatic vessels and glands are affected.

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[1] Beiträge zur Statistik der Seuchen in Bayern. Thierärztl. Mittheilungen der Münchener. Th. A. Schule, II. 17, p. 83.

[2] Moniteur des Sciences médicales, 1861.

The tubercular form of Glanders.—If the mode of development of the tubercles upon the mucous membrane of the nasal cavity is carefully studied at any one place, there will be observed at first miliary and submiliary elevations projecting from a more strongly injected background, and rendered visible by their turbid-white or yellowish-white opaque central portion. These points gradually enlarge, varying in size from a pin-head to a hemp-seed, and appear either isolated or united in larger groups. Upon careful observation there may often be seen a gray, transparent zone around this turbid white centre, and beyond this a faintly marked red areola. Upon section these tubercles appear succulent, of a grayish-white color, while the centre seems somewhat turbid, and frequently softened. In consequence of purulent degeneration of the superjacent mucous membrane there ensues a slight erosion, and a small, isolated ulcer is rapidly formed. The small ulcers thus developed soon enlarge, presenting an eroded base and slightly everted edges. The confluence of adjacent ulcers results in the rapid formation of larger ones, upon the base and edges of which new tubercles arise, and these in turn by their rapid disintegration contribute to the enlargements of the ulcers. The surface of these glistening ulcers is for the most part covered with a yellow-white puriform secretion, frequently foul-looking, and tinged with blood. These ulcers, after they have existed for some time, are apt to attack the cartilage and bone, producing more or less destruction of these tissues. Alterations precisely

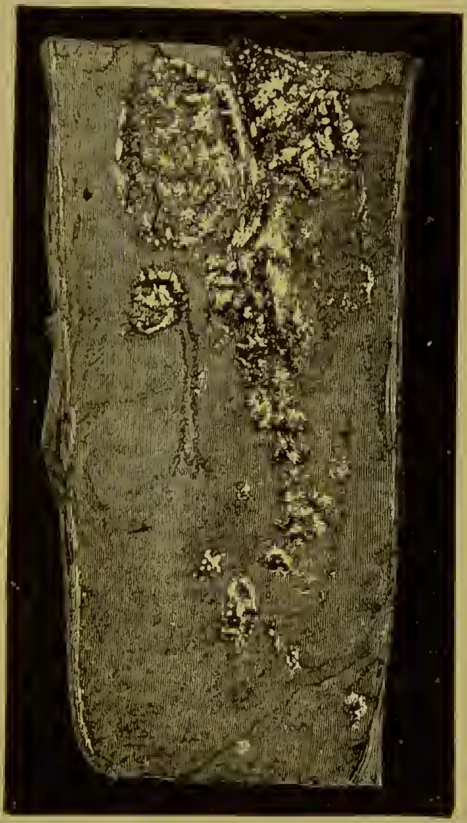

FIG. 1.

Extensive ulcers of the mucous membrane of the walls of the nasal cavity of a horse. The base of the ulcer corroded, the edges everted, and studded with tubercular growths. Toward the lower edge small ulcers of more recent formation, with tubercles in process of being transformed into ulcers.

similar are often also noticed within the cavities in the vicinity of the nose, and in the larynx and bronchi.

Microscopically these specific miliary tubercles are in reality composed of round cellular elements, not to be distinguished in most cases from pus-corpuscles, and approximating in appearance, especially in chronic glanders, to the pale and somewhat larger granulation cells. Whether these cells are formed by the growth of pre-existing elements, or by migration of the white blood-corpuscles from the vessels, is in the present state of our knowledge not to be determined.

There results, in consequence of the softening of the tissue, and the granular and purulent degeneration of the newly formed cell elements, a central disintegration of the papules, while in other cases an ulcerative process is established. These ulcers, in the case of chronic glanders, may heal, being transformed into stellated cicatrices; in most instances, however, there are produced in the neighborhood a continuous succession of new tubercles and ulcers.

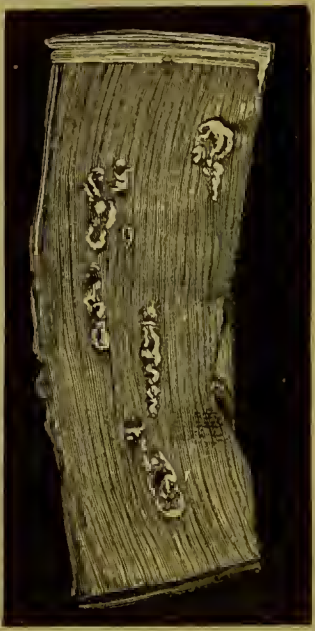

FIG. 2.

Acute ulcers in the mucous membrane of the bronchus of a horse. The base of the ulcer greatly excavated, and the edges considerably everted. At one point a tubercle may be seen in process of being converted into an ulcer. The other ulcers are partially confluent.

The specific tubercles of the lungs, in the early stage of their formation, bear a very close resemblance, when viewed with the naked eye, to miliary tubercles; they are, however, never found in so large numbers as in the miliary tuberculosis of man. They are composed, at first, of a cloudy-white or pale-yellow, punctiform, central portion, encircled by a grayish, translucent zone, which in turn is surrounded by a red, inflamed, and hyperæmic areola. Microscopically, these tubercles consist of a vascular,[1] delicate stroma, filled throughout with numerous round cells crowded together in clusters, and presenting the appearance of pus-corpuscles or ordinary granulation cells. In acute glanders they attain, at the most, the size of a pea; in the subacute, or chronic course of the disease, they become larger, varying in size from a walnut to an apple, and then assume often in part a fibroid structure.

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[1] *Leisering* demonstrated, by means of artificial injections, the existence of blood-vessels in the nodules of the lungs found in glanders. I myself saw in one nodule, which had become injected by natural means, large capillaries distended with blood, very similar to the newly formed capillaries in the granulations of wounds.

From the fact that these nodules and tubercles have an irritating effect upon the surrounding tissue, marked inflammatory changes are found, in the acute stage of the disease, involving the parts in their immediate vicinity; these changes take on the form of a circumscribed desquamative pneumonia, combined with vitreous, hyaline swelling of the tissues, and considerable distention of the blood-vessels. At a later stage in the progress of the disease, there is often formed a capsule of connective tissue around the tumors, which then show signs of fatty or caseous degeneration, calcification, or gangrene.

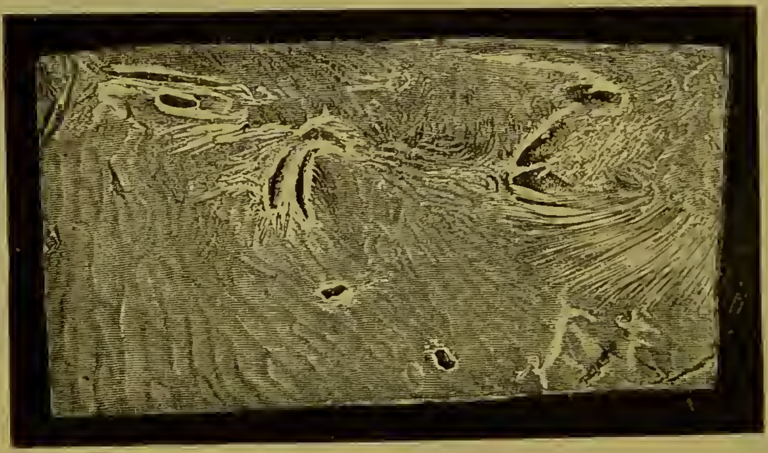

Fig. 3.

The indurated cicatrized portions of the mucous membrane of the *septum nasi*, the *sequelæ* of healed ulcers. These parts present a white, glistening appearance, and are but meagerly supplied with blood-vessels, while their surface is rendered uneven by the stellated cicatricial bands of connective tissue, all of which converge toward a common centre. Towards the left, and lower down, fresh ulcers of a more recent crop.

In the cutaneous variety of glanders, or farcy, the specific nodules are located in the cutis, or else in the subcutaneous cellular tissue, and penetrate frequently into the muscles. They vary, moreover, in size, from a pea to a cherry, those of most recent formation being usually overlooked. They are not sharply defined from the surrounding tissue. Their minute structure is the same as that of the nodules of the nose and lungs. The process of central disintegration advances rapidly, the superficial openings giving rise to the so-called farcy ulcers, which have an eroded and generally foul appearance, discharging a creamy secretion of a grayish-yellow color, frequently tinged with blood. With these phenomena there is generally combined an inflammation of the lymphatic vessels, which become distended by a yellow, purulent liquid, and are decidedly thickened, so as often to resemble a string of pearls ("farcy buds"). The corresponding lymphatic glands are similarly affected, becoming enlarged in cluster form, at some points taking on a form of hyperplastic swelling, and at others being studded with miliary tubercles. In the chronic variety the lymphatic glands become indurated, in the same manner as is observed in the infiltrated form.

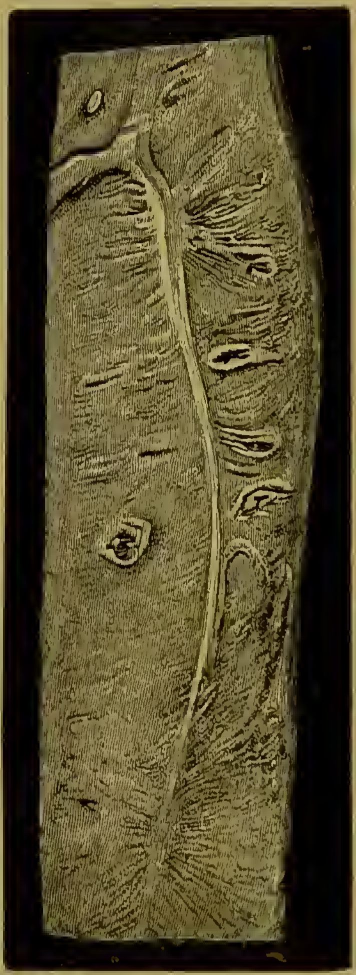

FIG. 4

An elongated cicatricial band, with lateral projections, situated in the mucous membrane of the *septum nasi*, found in a horse affected with chronic glanders. The cicatricial tissue firm, white, glistening, poorly supplied with blood-vessels, forming a long, strong band, with here and there radiating projections, which, on the right, enclose several small ulcers in process of repair. On the left, an isolated ulcer, likewise in process of healing.

The infiltrated form of glanders, inflammatory glanders (*diffused glanders*, Röll).—This variety of neoplastic formation is found most frequently in the mucous membrane of the nose, and neighboring cavities; less often in the larynx and bronchi, and more frequently again in the lungs, skin, and subcutaneous tissue. In many respects it resembles ordinary inflammatory processes. Tubercular growths are, as a rule, found in the immediate vicinity. Patches of the mucous membrane of the nasal cavity, varying in size, become livid, swollen, and infiltrated with a gelatiniform serous liquid, the result of a diffused deposit of round cellular elements in the cavities and interstices of the connective tissue.

As in ordinary diphtheritic infiltrations, there is produced, in consequence of the excessive deposit of cellular elements, gangrene of the tissue, recognizable by the excoriation of the superficial integument and the formation of ulcers.

In this manner are formed extensive checkered ulcers, the bases of which project above the level of the mucous membrane. the edges being slightly raised. These formations are often designated diphtheritic ulcers. Frequently solitary points only of the superficial surface are involved in the ulcerative disintegration now beginning. In the immediate vicinity are often found very small tubercles or small infiltrations varying in size from a hemp-seed to a bean; in other cases the tubercular growths may be altogether wanting.

It is significant, therefore, that these checkered ulcers, which attain frequently the size of the palm of the hand, should have been formed, not by the confluence of numerous isolated tubercles and ulcers, but in the manner above described. The surfaces of these ulcers present likewise an eroded appearance, generally of a cloudy-white or grayish-white color, and in many instances having a pale red hue.

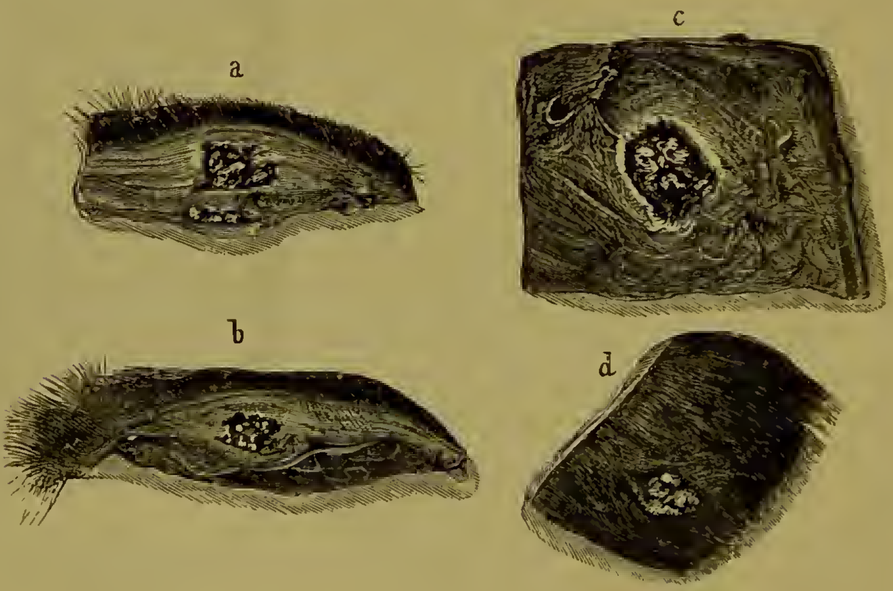

FIG. 5.

Specific nodules of the skin ("farcy buds"). *a* and *b*, nodules as seen in perpendicular section: the abscesses filled with thickened pus are in both instances enveloped in a dense capsule of connective tissue: at *a*, on the point of bursting. *c*, "farcy buds," with central puriform softening; capsule of connective tissue seen from within. *d*, farcy ulcer of the skin.

A more frequent result of these infiltrations is induration and the formation of cicatricial tissue. In that case the mucous membrane of the nose at the points affected becomes more or less firm, indurated, and of dark-brown hue, while on the surface may be seen, according to the extent of the loss of the tissue, either cicatrices of diverse shapes, for the most part stellated, or a smooth, shining, epithelial covering. Upon making a thin section of such an indurated mucous membrane, it is found to be composed of connective tissue, more or less rich in cellular elements, with recently formed vessels, but devoid of mucous glands. These specific cicatrices and callosities represent, therefore, ulcers that have been actually healed; the former may also be produced in another manner, from isolated ulcers formed from the disintegrated papules.

These specific infiltrations occur exclusively in the chronic variety of glanders, and were first accurately described by Leisering, whose views on this point were corroborated in the main by Virchow. The latter differed from Leisering in this respect only, that he admitted the possibility of genuine specific cicatrices being formed from ulcers, whereas Leisering maintained that the cicatrices produced by the infiltrations were not to be regarded as evidences of healing specific lesions, but merely as a special form of neoplastic growth concomitant to the disease. My own experience as regards this point confirms the views of Virchow, in accordance with which the specific ulcers, whether developed from tubercles or from infiltrations, are actually capable of healing, and the cicatricial tissue represents, therefore, the effects of a reparative action.

Before proceeding to the consideration of the specific infiltrations of the lungs, it may be well to refer to one of the most constant and by no means unimportant complications which is often encountered among the different nasal phenomena of the glanders. This lesion is connected with the veins, especially those found in the erectile tissue of the *septum nasi*, and consists in an *extensive formation of thrombi* in these vessels, accompanied usually with thrombosis of the lymphatic vessels. The obviously erroneous theory based upon this phenomenon, that acute glanders is nothing else than a phlebitis of the nose (*rhinophlebitis*), has already been exploded by Virchow. On the other hand, it must be admitted that this secondary thrombosis of the venous plexus of the nose has indeed a by no means unimportant influence—more particularly in connection with the thrombosis of the lymphatic vessels—in the development of the specific lesions found in the nose. The great extent of the infiltrations, their persistent character, and the extensive swelling and inflammation of the entire mucous membrane, are attributable, in part, surely, in such cases, to thrombosis of the vessels.

Specific infiltration of the lungs is of frequent occurrence, especially in the subacute and chronic form of the disease. This lesion is found in the vicinity of the tubercles and nodules, and is observable most frequently upon the anterior and lower edges of the lungs. On account of the decidedly inflammatory and exudative character of this change, it may be termed also the pneumonia of glanders (*pneumonia malleosa*), and its resemblance, moreover, to the tuberculous infiltrations has been also insisted upon by other writers (Virchow). The parts attacked appear at the outset to contain no air; they seem to be infiltrated with a gelatiniform substance of a dull-white or cloudy-yellow color, and of a pretty firm consistence. They may attain the dimensions of a pigeon's or goose's egg, and in many instances that of a child's heart. The histological alterations correspond to those of indurative pneumonia. The process may terminate in partial puriform softening, caseous degeneration, calcification, or also in ichorous degeneration, and finally in an indurated neoplastic formation made up of connective tissue, whereby the entire part acquires a dense, firm appearance (carnification), enclosing often regular cavities.

The specific infiltration of the skin, subcutaneous cellular tissue, and neighboring muscles corresponds in general to the analogous process in the mucous membrane of the lungs, though in the former parts the lymphatic vessels play a more important rôle. The ultimate result is induration of the subcutaneous cellular tissue, and often the formation of ulcers and abscesses.

Erysipelatous swellings often appear in acute glanders, especially upon the extremities; these may be regarded as an acute specific infiltration.

Before adverting to the less significant changes in the remaining organs we will consider some of the *concomitants* and *complications* of the disorder occurring in the parts already referred to.

The *mucous membrane* uniformly presents the appearance of some catarrhal or inflammatory affection, the favorite seat of this specific eruption being the *septum nasi* and the *conchæ.*

So far as my personal observations extend, in one-third of all cases of glanders, both sides of the nasal cavity are involved; in one-third of the number the right side alone is affected, while in the same proportionate number the left side only is diseased.

The nasal passages are often distended and filled with thickened pus, which fills also the cavities extending from the nose, especially those of the frontal and maxillary bones. The latter often exhibit, moreover, specific infiltrations, and less frequently a tubercular eruption. The fact that the mucous lining of these sinuses, as well as of the nasal passages, takes the place of the nourishing periosteum of the bony walls of these parts, will serve to explain how the bones may become implicated in the inflammatory process—a feature that is often observed, appearing in the beginning as a deposition of bony matter, later as an indurated hyperostosis.

In acute as well as in chronic glanders there is found in the mucous membrane of the larynx and bronchi, much more frequently than is commonly supposed, specific tubercles, infiltrations, and ulcers, accompanied often by extensive destruction of the tissues, the results of which are indicated by the loss of substance seen in the epiglottis, and in the destruction of the vocal cords and the cartilages.

In fifty-two cases of glanders, I observed twelve times, equal to twenty three per cent., ulcers of the larynx and bronchi; and that this calculation is in reality an under-estimate of the frequency of the occurrence of this symptom, is shown by subsequent and more exact observations made by me (in Zürich), where in eleven cases, four only were free from these lesions of the bronchi and larynx. To these specific lesions then, which, as I am inclined to estimate, may be detected in from fifty to sixty per cent. of all attacked, too little attention by far has hitherto been directed, a remark which is also applicable to the pulmonary phenomena of the affection. A few cases have been already referred to in which these organs alone were invaded by the specific symptoms, the nose remaining perfectly intact, or at

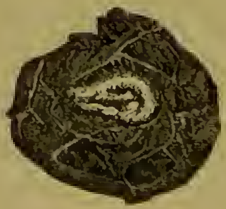

FIG. 6.

Specific nodule from a muscle from the body of a horse, of pretty firm consistence, and showing no signs of disintegration or softening.

least becoming only secondarily affected. In fifty-two cases of glanders and farcy, the lungs were perfectly sound in four cases only, equal to 7.6 per cent.; of these, two were cases of farcy, one of acute glanders and farcy, and one of farcy with secondary nasal symptoms. In the same fifty-two cases, the nose remained entirely free from disease in five cases.

There is frequently found as a concomitant disorder, in lungs affected with glanders, *bronchitis* in its different varieties, or simple *broncho-pneumonia*, especially in the anterior and lower portion of the lung, induced by the settling of the bronchial secretions. It is a questionable point to what extent this form of circumscribed pneumonia, which has its chief origin in mechanical influences, can be included under the head of glanders, if indeed it can be referred at all to this process. It is not uncommon to meet with cases of cheesy pneumonia of the lobular variety, induced, as I am inclined to think, by an acute or subacute specific infiltration.

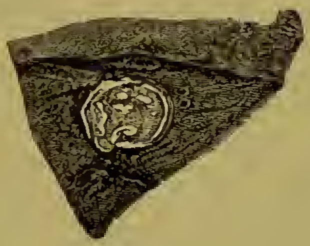

FIG. 7.

Specific nodule from the liver of a horse. The nodule is almost completely calcified, and enveloped in a capsule of connective tissue.

The specific nodules also occur in the large internal glands, such as the *liver*, *spleen*, *kidneys*, and *testicles*, though with far less frequency than in the muscles. They are found in moderate numbers lying either beneath the peritoneum or in the parenchyma, and they vary in size from a pin-head to a pea, rarely being larger; they are of a grayish-white color, with a yellowish-white softened centre, and surrounded with a dark red areola.

In the *liver* these tumors have an especial tendency to calcification. In acute glanders, moreover, the above-named parenchymatous organs usually manifest, to a greater or less extent, the lesions of the so-called *cloudy swelling*, with granular degeneration of the epithelial and glandular cells.

Finally, *leucocytosis* of the blood is a constant accompaniment of glanders in horses. The increase of the white corpuscles is in many instances so marked as to give the appearance of leucæmia, this increase being manifestly due in a great measure to the irritation excited in the lymphatic glands by the presence of the specific poison. The parasites detected by some in the blood of glandered horses, I have not been able to find in the blood of living animals; on the other hand, bacteria are frequently seen in the blood of horses a few hours after death, independently of the disease with which they may have been affected.

Whether the *abscesses* that have been found in the various parts of glandered horses (for instance, in the brain, upon the neck, and in the parotid gland) are in like manner attributable to the specific blood-poisoning, or whether these are possibly to be referred to secondary embolisms, future researches can only determine.

Concerning the relation of glanders to analogous diseases,—to tuberculosis, syphilis, lepra, lupus, radesyge, etc.—I concur fully with the views of Virchow, remarking only that the vascular structure of the nodules, and the absence of giant cells distinguish it clearly from miliary tubercles, genuine forms of which occur, though in extremely rare instances, in the lungs of horses; they have, however, no connection whatever with glanders.

Symptomatology, Course, Duration, and Termination.

The period of incubation lasts usually, when the virus is artificially implanted, from three to five days, seldom longer. On the other hand, when the contagium is spontaneously communicated, it is said that weeks and months may elapse before the appearance of the first symptoms. The notion of any such difference, however—a difference that in the history of infectious diseases would be unique—must have its origin in imperfect observation and the insidious approach of the early symptoms that so often occurs. According to my own views, the reasons for which I have already endeavored to state, the alleged long periods of incubation are to be explained in the following way: either a constitutional blood-poisoning, or a localization of the disease in the internal organs continued after the primary symptoms—those manifested upon the external skin or mucous membrane of the nose, for instance—had healed; or else—which may be of more frequent occurrence—the virus was implanted through the agency of a volatile infecting principle, which excited local changes in the lungs, bronchi, larynx, and upper part of the nasal cavity, and yet did not prevent the animal from presenting, to all external appearances, the picture of perfect health.

According to experiments made by Chauveau, horses in which the disease has been artificially implanted—either by injection of the poison into the veins, or by feeding with infected substances—exhibit an increase in pulse and temperature, as well as other symptoms of fever, although in this stage of the disease no alterations can be detected after death, either in the lungs or nasal cavities.

In chronic glanders, the duration of which may be prolonged from a period of months to a year and longer, the disease cannot be diagnosticated, if the symptoms are confined exclusively to the invisible internal organs; and the case is equally obscure when the primary morbid deposits have been overlooked.

With the above exceptions, however, when nodules and ulcers are present in the nasal cavity, the onset of the disease is characterized by the appearance of a nasal catarrh, which is frequently confined to one side. The discharge, at first clear, becomes gradually turbid, viscid, and purulent, drying on the edges of the nostril, and is expelled in solid masses. Upon an examination of the nasal cavity by the eye—which, if the local lesions are situated posteriorly, will be materially aided by the employment of a mirror—or, if the finger be introduced into the cavity, the characteristic tubercles and ulcers will be found, especially upon the sides of the *septum nasi*. The submaxillary glands upon the affected side will also be found to be enlarged, forming often an irregular mass the size of a walnut. These have a hard feel, are not painful to the touch, and are, as a rule, not movable with the integument, owing to the fact of their being adherent to the ramus of the jaw beneath. When the nasal ulcers have attained a certain size, the discharge becomes decidedly purulent, and often foul-looking, being tinged with blood. It produces then excoriation of the parts over which it flows. In the majority of cases little or no constitutional disturbance is excited. Upon longer duration and more complete development of the disease in the lungs, the animals fall away, the appetite diminishes, emaciation ensues, and with the signs of increasing cachexia death ultimately takes place, febrile symptoms having in many instances previously set in. Cicatrization of single ulcers, calcification and resolution of the nodules of the internal organs may take place, but these changes are not of frequent occurrence.

When in the course of *chronic glanders* there are developed still other specific affections of the superficial integument or of the cutaneous connective tissue, or when *farcy is superadded* to glanders, there are formed upon different portions of the body, most frequently upon the extremities, head and neck, abscesses and nodules, of the size of a hazel-nut, which at the outset are hard and painful. While these abscesses are more or less rapidly breaking out, the *farcy sores* make their appearance, from which an exceedingly foul, sanguino-purulent discharge is poured out. These ulcers are for the most part deeply excavated, and have turbid-gray or grayish-red glistening bases, with elevated, usually ragged-looking, edges. The surrounding cellular tissue is generally indurated and swollen; the corresponding lymphatic vessels swell, giving to the touch the idea of a cord ("farcy pipes"). Finally, the neighboring lymphatic glands are enlarged, hard, and at first somewhat painful.

In *acute glanders*, whether in the form that is developed from the chronic, or in that which appears at the outset as such, there is to be seen, joined with marked febrile appearances, an excessive, hyperæmic swelling of the mucous membrane of the nose, upon which, in the course of a few days, numerous tubercles, ulcers, and infiltrations may be made out. The nasal secretion is of a yellow tinge, viscid, and often sanguineous. The ulcers spread rapidly, even in the direction of the air-passages, and in the neighboring lymphatic glands and vessels the changes peculiar to lymphangitis and lymphadenitis may be found. There are frequently seen "cords" in the scalp, which in some places may be œdematous. As the fever and prostration increase, the nodules and ulcers often appear in other portions of the body, accompanied by œdematous swelling of the extremities, the lower portion of the abdomen, and the breast. The animals grow thin, and, after an illness varying in length from eight to twenty-one days, death ensues.

When the *mucous membrane of the larynx and bronchi* is affected, the animals begin to cough and to manifest great sensibility in the laryngeal region.

In cases where the *process of pneumonia is extensive*, and in *bronchitis*, a physical examination of the chest will indicate the nature of the internal lesions. As a rule, however, glanders of the lungs is not diagnosticated.

The *varieties of the affection running a more subacute course* present numerous intermediate features between acute and chronic glanders, on which account an exact classification is often impossible. With regard to the relation between acute and chronic glanders, it is proper to observe in this connection, that the latter variety is often found to produce, by inoculation, the former.

Although the chronic form often has an acute termination, the acute form is never transformed into the chronic.

Diagnosis.

The diagnosis of glanders is, as may be inferred from what has already been stated, in many cases extremely difficult, or even absolutely impossible, and the latter is especially true in cases where the lungs form the seat of the trouble, or where the specific morbid processes are situated mostly in those portions of the respiratory organs which, from their location, do not admit of an examination. In such cases it is erroneously concluded, as we have already seen, that the disease has been spontaneously developed, or that there has been an extremely long period of incubation. The trephining of the sinuses of the jaws, as proposed by Haubner, may often render a correct diagnosis possible. In general, the inoculation of another horse, or of some other animal having a susceptibility to glanders (sheep, goat, rabbit), forms one of the surest aids to diagnosis.

The auto-inoculations attempted in several instances (Haubner, Harms), gave generally a negative result, or else the local effects of inoculation rapidly disappeared without treatment.

As regards diagnosis, moreover, it not unfrequently happens that the symptoms are confounded with those of other processes, especially of simple catarrh of the mucous membrane of the nose and neighboring cavities, with the so-called "Druse" (non-malignant catarrhal rhinitis, with swelling of the lymphatic glands), and, furthermore, with the croupous and diphtheritic affections of the nasal cavity accompanying croup and diphtheria. Upon the skin, simple erysipelas, lymphangitis, etc., may often be mistaken for farcy.

Prognosis.

The prognosis is always unfavorable. Although from a purely anatomical point of view the possibility of these ulcers being healed must be admitted, yet perfect recovery is indeed an extremely rare occurrence, inasmuch as in the vicinity of the healed portion new eruptions, as a rule, break out. The numerous reports of the healing of glanders and farcy have their origin, in a great number of cases, in errors of diagnosis, or else the recoveries were only apparent, the temporary arrest of the discharge from the nasal cavity being mistaken as an indication of recovery, whereas subsequently, genuine glanders and farcy reappeared.

The nearest approach to a successful result is seen in the reparative action occurring in the primary tubercles and ulcers of the skin.

Treatment.

The external treatment consists in the application of the different caustic agents; internally, the various salts of potash (bromide and iodide of potassium, chlorate of potassa), iodide of copper, calomel, arsenic, and arseniate of strychnine[1] may be given. In this connection, reference should be made to the method of repeated inoculations, which, as in the analogous method of syphilization, was said to afford immunity against the contagion of glanders, and was tested experimentally, in Copenhagen, by Bagge and Tscherning.[1] The result of this "malleosation" was, that repeated inoculations (as many as 160) with the pus of glanders and farcy neither produced recovery from the disease nor prevented a fatal termination; but, while tending in no way to modify the usual symptoms, seemed rather to accelerate death. No absolute immunity from this disease is to be obtained.

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[1] In most European states the treatment of the disease, after a sure diagnosis has been made, is forbidden by law, and the affected animals must be forthwith destroyed.

GLANDERS IN THE HUMAN SUBJECT.

Historical Notice.

For the first researches, incomplete though they were, concerning the injurious effects of the virus of glanders upon man, we are indebted to a French military surgeon, Lorin,[2] and also to Waldinger,[3] Veith,[4] and others. Lorin observed, in the case of a veterinary surgeon, an extensive inflammation of the fingers of both hands, resulting from an injury received during an operation upon a glandered horse. Fourteen days after the extirpation of the small tumors that had formed, complete recovery ensued. According to Waldinger, when the infected pus is brought in contact with an abraded surface in man, an incurable fatal disease of the glands is produced. Veith, in like manner, affirms that he has observed severe inflammatory processes resulting from inoculation with infected substances, the surrounding lymphatic glands becoming thereby sympathetically affected.

To the regimental surgeon Schilling, of Berlin (loc. cit.), must be accorded the honor of having been the first to give an exhaustive description of glanders as it affects the human subject. A well-marked typical case was described by this writer in 1821. Rust and Weiss soon after described a second case, which was rapidly followed by numerous similar communications (Seidler, Wolff, Grossheim, Eck, Brunzlow, Lesser). Meanwhile, in

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[1] *Hering*, in Canstatt's Jahresbericht f. 1858, p. 30.

[2] Observation sur la Communication du Farcin des Chevaux aux Hommes. Journ. de Méd., Chirurg. et Pharm., Février 1812.

[3] Ueber Krankheiten an Pferden und ihre Heilung, 2 Aufl., p. 158. Wien, 1816.

[4] Handbuch der Veterinärkunde, 2 Aufl., § 685, 1822.

England, Travers (1827) and Elliotson (1833) published valuable observations, and later there appeared the admirable monograph of Rayer (1837), and in 1843 that of Tardieu. Passing over a large number of miscellaneous articles that have appeared each year since that date, the works of Virchow (1855 and 1863) have above all contributed materially to our knowledge of glanders in the human subject, in connection with which may be mentioned the monograph of Korányi (1870).

Etiology.

The source of glanders in the human subject can uniformly be traced to diseased horses. The question that has been discussed at different times and places, as to whether glanders can arise spontaneously in man (Trousseau and Teissier), appears to me to have been clearly solved when the fact was once established that in the case of horses it is a purely infectious disease. The few alleged cases of spontaneous glanders in man are either based upon diagnostic errors, or otherwise the mode of infection was such as could not be apprehended, as may be often enough observed in the glanders of horses, as well as in all infectious diseases.

There are very many ways in which the virus of glanders may be transferred from horses to the human subject. If the mode of origin of the disease be carefully studied in a large number of cases, the diverse forms of the malady will be found to range in this respect under two different categories, namely, *those cases occurring after known infection*, and *those appearing without any evidence of infection* (Küttner).

To the first group belong those cases of infection in which the specific virus has forced its way into the system after the reception of some *injury of the hands* (especially minute wounds, excoriations, cracks, and hangnails), the patient being inoculated either while grooming or feeding glandered horses, or else whilst handling or examining such animals, whether alive or dead (for example, during the operation of venesection, skinning, slaughtering, or making an autopsy). Still another mode of infection may be observed; as, for instance, when the mucous membrane of the nose, mouth, or conjunctiva of the eyes forms the point of entrance; this latter mode of origin is most frequently produced by the snorting[1] of a glandered horse, by which act small particles of mucus and pus are driven against the above-named organs, where they are capable of producing infection. Infection by means of the bite of a glandered horse has in some few instances been observed, in which cases the saliva manifestly furnished the vehicle for the poison.

There can be no doubt but that the infection of glanders may be produced by *eating the meat* of glandered horses, which, according to my experience, owing to the imperfect sanitary regulations for the inspection of meat, is not unfrequently used as food. The common processes for preparing the meat for the table would naturally tend, it is true, to destroy its virulence; but meanwhile the risk of infection is incurred by the manipulations involved in preparing it.

The fact has already been alluded to, that glanders is not of unfrequent occurrence in lions confined in menageries and zoological gardens, when these animals have been fed for a time upon the meat of glandered horses. In this connection the bold experiments of Decroix[2] should be mentioned, though it is not easy to credit them. Decroix consumed with impunity the meat of horses that had been killed on account of farcy or glanders, the meat having been cooked in various ways (boiled, roasted, and stewed). He asserts, moreover, that upon seven or eight occasions he ate even the raw meat of glandered horses without ill effects.

Infection from contact with diseased horses, arising independently of any previous abrasion or wound, has also been observed in a few instances (Ungefug, Röll), where the poison must have penetrated the skin through the cutaneous follicles. A more indirect mode of communication occurs in rare instances through intermediate vehicles, for instance by drinking from the same pail that has been used by a glandered horse, by wiping a wound with an infected blanket, or by using the same handkerchief, that has been employed to cleanse the nose of a diseased horse.

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[1] The snorting (Ausbrusten) is a mode of blowing through the nose peculiar to the horse, by means of which the contents of the nasal cavity are forcibly expelled, the process being accompanied by a loud noise. It can be best likened to the sneezing of man, and is occasioned by any irritation affecting the mucous membrane of the nose.

[2] *Decroix*, Bulletin de la Soc. centr. de méd vétér, Année 1870–71.

Under the *second class of modes of infection occurring without known local inoculation*, come all those cases whose origin is attributable to a volatile infecting principle. This mode of infection may be inferred in all cases in which the general constitutional disease precedes any localization of the symptoms.[1] It is also observed in the case of individuals who groom and have the care of glandered horses, who sleep in a stall with diseased animals—without in any manner coming in direct contact with them—or who become infected by sleeping on straw upon which, shortly before, glandered horses have been standing.

Errors in diagnosis are not unfrequent. Many instances of alleged glanders occurring in man (those of Zimmermann[2] for instance, which were throughout graphically described), which have been reported as arising from atmospheric contagion, were, in reality, as has been demonstrated by other writers (Küttner and others), not glanders at all, but cases of typhoid fever.

The *communication of glanders from man to man* has been known to occur in extremely isolated instances only, for example, where one has eaten from the same dish with a diseased individual, or when an entire family, consisting of man, wife, and four children, have been rapidly attacked one after another with the malady.

Susceptibility.—The question as to how great an affinity is manifested by the human subject for the virus of glanders, I can answer in a measure from my own experience, viz., that this affinity is on the whole moderate, not to say slight. When we consider the manifold opportunities for infection, especially during the handling, examination, and autopsy of diseased horses, and then compare with that number the proportionately small number of cases of infection, the correctness of this statement will be made manifest without further argument. As with horses, so also with the human subject, a peculiar individual susceptibility appears essential to insure the propagation of the virus, many individuals being in every way frequently exposed to infection without contracting the disease.

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[1] An absorption of the poison with the *ingesta* would be also possible in such cases.

[2] Virchow's Archiv f. pathol. Anat., B. 23, p. 209-415, 1862.

If furthermore we inquire what class of persons become most frequently the victims of contagion, we shall find, as would be expected from the description of the methods of communication above given, that those are most liable to contract the disease who, from the nature of their occupations, are brought into frequent contact with horses. *In about ninety per cent. of the cases occurring in the human subject, the affection will come under the head of genuine industrial diseases.*

The following table will give the best idea as to the *frequency of glanders* in workmen of different occupations.

In 106 cases of glanders collated by me, there were found to be:
41 hostlers,
11 Coachmen, drivers, or postilions.
14 Land proprietors and horse-owners.
10 Veterinary surgeons and students in veterinary medicine.
12 Horse-butchers and flayers.
5 Soldiers.
4 Surgeons.
3 Gardeners.
2 Horse-dealers.
1 each: Policemen, shepherds, blacksmiths, *employés* at veterinary school.

No further comment upon this point is needed, if the fact be regarded that the female sex constituted only five per cent. of the cases of glanders, six only out of 120 cases being found to occur in females. The infected women were for the most part maids who were obliged to take care of diseased horses, or the wives of hostlers and drivers, the communication of the virus being accomplished through the agency of an intermediate object.

In like manner children enjoy still greater immunity from infection. Out of the same 120 cases one diseased child only was found, and that proved to be the child of a coachman who had been brought in contact with glandered horses.

Symptomatology.

Incubation—Classification.—When the infection of glanders has once taken place, either by the transfer of the fixed *materies* *morbi* to an abraded skin or mucous membrane, or by the agency of the volatile poison, drawn in probably by the act of inspiration, there will be observed a prodromal stage lasting from three to five days, but which is said to be prolonged in many instances to fourteen days, and even three weeks.

The introduction of the virus through the unabraded skin is at all events limited to some quite exceptional cases, and has been demonstrated to a certainty in a very few instances only. If we consider how easy a thing it is to overlook small excoriations and desquamations of the epidermis, and if, too, we reflect that the points of inoculation may rapidly heal, we shall have no difficulty in accounting for many of the alleged cases of infection through the intact skin.

In the attempt to classify glanders in the human subject according to the diverse phenomena manifested by the different forms of the disease, the division has been made by some authors, with respect to its *localization*, into glanders and farcy, while by others the *duration* has been selected as the basis of classification, and the disease divided into a long list of subdivisions. In this respect, however, Tardieu went to the greatest extreme, recognizing no less than six different forms of glanders in man.

This fanciful subdivision cannot be said to be based upon any pathognomonic lesions, and is, moreover, in a clinical point of view, of no practical utility, for if we examine the symptoms of a large number of cases, we shall hardly find any uncomplicated instances of either glanders or farcy. The simplest and most practical classification would appear to be that based upon the course and duration of the malady, and I have, therefore, deemed it best to recognize the *acute*, *subacute*, and *chronic* varieties.

The distinct line of division drawn by many authors between acute and chronic glanders has no real existence, and for this reason we are justified in recognizing an intermediate form, designated by the term subacute. In seventy-nine cases of glanders in the human subject, which admitted of accurate classification according to their duration, thirty-eight were acute (lasting as long as four weeks), seven were subacute (lasting from four to six weeks), and thirty-four chronic (lasting longer than six weeks).

It is maintained by some writers that the infection induced by the fixed virus assumes an acute form, whereas the volatile virus induces the chronic form, or vice versâ. These theories, the latter of which has been supported especially by Küttner (loc. cit.), do not appear to me to be supported by any sufficient proof.

ACUTE GLANDERS.

In twenty-eight cases of acute glanders, of which number one only did not terminate fatally, the average duration, not reckoning the period of latency, amounted to 16.5 days. Instances in which the duration was from seven to eight days are rare. For the most part the disease lasts from two to three weeks, though frequently it is prolonged to four weeks.

The *initiatory symptoms* consist frequently of malaise, fatigue, and prostration, accompanied by headache and chills, and often joined with obscure pain in the extremities, especially in the muscles and joints. While at the outset of the disease no appreciable cause for these rheumatic pains can be made out, distinct local symptoms soon appear on the skin or in the muscles, in the form of circumscribed or diffused lesions.

If a wound or excoriation forms the point of entrance of the virus, there is then experienced at that point, usually situated on the hands or face, a sensation of pain, followed by a redness and inflammation of the part involved, and finally swelling, and often inflammation of the surrounding lymphatic vessels.

The disease is seldom ushered in with a chill, and all indications of fever are frequently wanting. As the pains become more severe, regular fever turns often supervene, or a continued fever appears.

Meanwhile the ulcer enlarges, its edges and base acquire an unhealthy aspect, the pus discharged being of an offensive character ; often the whole ulcer assumes a corroded, chancroid character, and a dirty white hue. If the wound is situated on the finger, there is often observed a swelling of the arm, at times of a phlegmonous and erysipelatous form, accompanied frequently by a formation of pustules and ulcers.

The constitutional symptoms are then aggravated, the appetite fails, and gastric disturbances follow with constipation ; the patients manifest very great prostration, the pain in the joints and muscles becomes more violent, and the febrile disturbance constantly increases.

Where the early history of the patient is imperfect, and when the disease has been produced by a volatile infection,—in which case, of course, outward signs of infection will be absent,—the disease presents, as a whole, a picture very similar to that of the early stage of typhoid fever, or, in other cases, when the pain is excessive, to that of acute articular rheumatism. When the fever is slight, the premonitory symptoms are often intermittent; the patients give up their business, and complain at most of weakness, fatigue, and general discomfort.

In the further course of the disease, there appear frequently on different parts of the skin red spots, which change into pustules like those of small-pox, and less often into pemphigus blebs. The pustules, about the size of a pea, often arise in large numbers, bursting and discharging a thick, mucous, sanguineous pus, emitting often an offensive odor. There may, on the other hand, be developed large projecting tumors and abscesses, that become extremely painful and hard, but then gradually change to a doughy consistence, fluctuate, and after they have been lanced, or have spontaneously opened, present the appearance of extensive ulcers with irregular edges, covered with a white deposit. These ulcers often penetrate so deep as to lay bare the tendons and bones.

All these cutaneous affections—the erythema, the erysipelatous and phlegmonous processes, the abscesses, pustules, and ulcers—are often spread so extensively over the surface of the body that hardly any part remains free. Frequently there appear swellings of different joints, to which may be superadded periarticular non-fluctuating tumefactions.

Although the pustules and abscesses are often developed quite rapidly,—within from twenty-four to forty-eight hours,—in other cases they only appear at the end of two, three, or four weeks, preceded in the meanwhile by a discharge from the nose, swelling of various portions of the skin, pains, and a feeling of indisposition.

The mucous membranes (and first of all that of the nose) manifest symptoms of inflammatory and ulcerative disease.

The localization of glanders in the mucous membrane of the nose occurs much less frequently in the human subject than in horses. According to Hauff (loc. cit.), out of seventy cases there were thirty in which affections of this organ were found.

When, however, the nose is affected, there may be seen at the outset a discharge of thin, viscid, light-colored mucus. Gradually there appear swelling and redness of this organ and adjacent parts, accompanied by severe pain; the upper portion is specially sensitive to the touch, exhibiting a diffuse, erysipelatous swelling. The nasal discharge, which is often secreted from one side only, becomes later of a thicker consistence, and more purulent, being often of a brownish-yellow color, sanguineous, and offensive. Less frequently, distinct tubercles may be made out, situated most commonly upon the *alæ.*

In many instances we may distinguish, even during life, the formation of pustules and ulcers in the mucous membrane of the nose, which, in the malignant type of the disease, terminate in erosion of the perichondrium, and perforation of the *septum* and *vomer.*

This secretion, from one or both sides of the nose, at first of a sero-purulent character, makes its appearance usually in the second or third week, attended by a diffused redness of the nose that spreads from this point over the forehead and face.

Thus it may be seen that in the *human subject*, just as in the horse, the *nasal affection fails often to appear until the later stage of the illness*, which affords convincing evidence that in both species these symptoms cannot be regarded otherwise than pathognomonic.

Synchronously with the appearance of the cutaneous eruption, or later, catarrhal, inflammatory, and ulcerative processes are developed in *other mucous membranes.* These alterations, which are more or less intimately connected with the nasal lesions, are seen, for instance, upon the conjunctiva of the eye, the mucous membrane of the mouth, the gums, the faucès, and the entire respiratory canal. Ulcers appear in the mouth, the gums show a tendency to bleed, the breath of the patient becomes offensive, the inflamed condition of the pharynx makes swallowing difficult, while the altered condition of the larynx produces hoarseness, an irritative cough and dyspnœa, and renders the act of speaking difficult.

The submaxillary and sublingual glands, which often take on a suppurative inflammation, are swollen and painful, while at times there may be formed abscesses that open externally.

In some cases there may be observed the symptoms of *gastro-intestinal catarrh.* In addition to the loss of appetite, the patient complains of gastric disturbances, indigestion, and constipation; while, in the later stages, diarrhœa is not an unfrequent symptom. The tongue is dry, thickly coated, and this organ and the gums appear often to be covered with a black, sooty deposit. Thirst is excessive, especially when the patient is suffering from diarrhœa. In a few isolated instances enlargement of the spleen has been diagnosticated during life.

In connection with the *respiratory apparatus*, there are often seen in addition to the specific changes above mentioned, the symptoms of bronchial catarrh; the patients cough severely, and expectorate profusely, the sputa bearing usually a strong resemblance to the discharge from the nostrils. Extensive rhonchi are heard over the walls of the chest, while the breath is in many instances fetid. At first, respiration is but partially impeded, but later absolute dyspnœa ensues.

The pulse is for the most part very frequent and small in volume, ranging from 110 to 120 beats a minute; but in some cases it appears to be retarded. The temperature reaches 104° F. and over, although at the outset symptoms of fever are often entirely absent.

The sympathetic affection of the *central nervous system* is indicated in the beginning by fainting turns, headache, tinkling sounds in the ears, insomnia, and great restlessness, to which disturbances may be soon superadded nocturnal delirium, and, provided there be numerous muscular abscesses or extensive cutaneous ulcers, chills and fever.

The exacerbations of fever are either irregular, or less frequently they may be of regular intermittent character.

In those cases, the course of which is rapid and the symptoms of a malignant type, there is considerable fever, which rages without remission, so that even in the morning the temperature may be as high as 106° Fahr.

Albumen has been found in the urine in some cases; also shortly before death leucine and tyrosine. In the case of pregnant women, abortion has been in several instances observed.

In the course of three or four weeks the patients relapse into a condition of general prostration, accompanied by considerable emaciation. The fever increases, the pulse grows weaker, delirium sets in, and there is developed a condition of stupor; the skin becomes cool, respiration short and irregular, the pupils dilated; involuntary evacuations ensue, and death takes place under symptoms of collapse.

At other times the dryness of the mucous membrane of the mouth and pharynx increases; the patients become hoarse and deaf; the nasal secretion has a foul appearance; now and then icterus also appears; an increased difficulty in breathing and in deglutition, an increase in the cutaneous patches and pustules, a loss of activity of the sensory organs, attacks of muscular cramp, and a loud snoring respiration culminate in a fatal termination.

CHRONIC GLANDERS.

The local phenomena, when the virus has evidently been implanted in an exposed portion of the body, are, in the initiatory stage, the same as those of acute glanders, and the same remark is true with regard to the constitutional symptoms where the infection has been produced by the volatile form of the poison. These symptoms consist in attacks of fever, pain in the various parts of the body, restless sleep, general indisposition, and a diminished appetite.

Swellings of certain parts of the body arise, their locality depending upon the point of entrance of the virus into the system—generally the face or extremities; there is seen, furthermore, inflammation of the lymphatic vessels, and swelling of the lymphatic glands. These local symptoms may abate, or even entirely disappear. The disease assumes then a quiescent form until some new local and constitutional features are developed.

The separate organs at this stage show the following alterations:—

The *external cutaneous ulcers* manifest no disposition to heal, but have a livid appearance, or here and there they may heal, at least the majority of them, by the formation of cicatricial tissue. New abscesses are constantly forming in the vicinity of these ulcers, and especially about the joints; there also appear sinuous and fistulous ulcers that secrete an offensive, watery pus, and show no tendency to throw out granulations. There are, moreover, frequently found upon the extremities nodular tumors, which upon being opened discharge thick purulent masses, mixed with blood and serum. In other cases pustules gradually appear, as in acute glanders, on every part of the body; also fluctuating tumors in the muscular tissue; erysipelas, especially upon the nose and face, and painful swellings of the joints. After the lapse of a few months, large abscesses may develop upon different regions of the body, complicated with inflammation of the lymphatic vessels and glands.

The *affections of the nose* in chronic glanders do not differ essentially from those of the acute form of the disease. They run a longer course, however, and very frequently—in one-half at least of all cases—they are entirely absent. They are usually characterized at first by the presence of an offensive muco-purulent discharge, but begin, sometimes, with a swelling of the nose, appearing a long time (two to three months) after the contraction of the disease; in rare cases gangrene of the swollen root of the nose may ensue. The nostrils are covered with foul crustaceous deposits. In the case of the mucous membrane of the nose, the disease takes on the form of ulcerative processes, which often terminate in destruction of the septum and vomer.

Chronic glanders is characterized by other features, such as inflammatory affections of the mucous membrane of the *mouth*, often joined with swelling of the tongue, salivation, the formation of ulcers upon the gums and throat, and finally angina.

The *organs of respiration* are but partially involved; the patients suffer from a slight cough and hoarseness, the sputa being often bloody. The difficulty in breathing is either very slight, or it increases with the development of extensive lesions in the larynx, and subsequent œdema of the glottis, until it amounts to actual dyspnœa, a symptom that is likewise produced by extensive affections of the lungs.

In consequence of the long-continued suppuration and pain, the patients become greatly debilitated and emaciated, presenting on the whole an appearance very similar to that seen in chronic tuberculosis with hectic fever.

The manifestations of the *fever* are manifold; when a series of abscesses follow in rapid succession, the fever is seldom absent; at other times, feverish exacerbations only occur in cases of a relapse and the formation of new eruptions. Colliquative diarrhœa, severe sweats, combined with general cachexia and exhaustion, generally precede the fatal termination.

The chronic form of glanders is often transformed—as in the horse—into the acute (Tardieu); numerous fresh abscesses suddenly appear, the fever becomes very high, the pulse small and rapid, and death ensues, as in typhoid fever, with symptoms of decided coma.

When the disease terminates favorably, as not unfrequently happens in the mild form of the malady, the symptoms above described are all much less pronounced. Cicatrization of the abscesses then takes place, while the cutaneous vesicles, both large and small, dry up. If the nose has been affected, the swelling of that organ diminishes, the discharge becomes less profuse and thicker, the general condition is ameliorated, the fever becomes very slight, the exacerbations cease, while the gastric and respiratory symptoms disappear.

The patients rally, for the most part, pretty slowly, in many instances never regaining complete health. An instance has come under my own observation in which the patient (a veterinary surgeon), after an illness lasting eleven years, continues to suffer constantly from cough and obstructed respiration, resulting chiefly from a cicatricial contraction of the mucous membrane of the nose and larynx, in consequence of which he presents the picture of decided cachexia.

In other cases, after months of severe illness, a pretty rapid improvement follows, and under favorable surroundings the patients soon recover their health. The average duration of subacute and chronic glanders, of which about one-half the number of cases terminate in recovery, was found to be (computing from about forty cases) four months, omitting in this estimate certain quite exceptional instances, in which the illness lasted from one to four and a half, and even eleven years, and omitting also those more frequent cases lasting from two to three months.

PATHOLOGICAL ANATOMY.

The post-mortem appearances bear in general a close resemblance to those of pyæmia.

Externally there are found in various parts, especially upon the fingers, and in general upon the extremities and the face, at some points, pustules or blebs, at others, abscesses and ulcers.

The cutaneous pustules, which often present a strong resemblance to those of small-pox, are found to contain, at one time, caseous-purulent contents, at another a sanguineous fluid. Beneath the larger blebs, which here and there are seen to be collapsed, are frequently found well-defined sloughs of a dull gray color.

The numerous abscesses of the cellular and muscular tissues are to be distinguished from ordinary abscesses chiefly by this circumstance, that their contents are often tinged with blood, and have a more viscous consistence, while the connective tissue or the muscular substance at these points is softened. Here and there are found subfascial abscesses, and the surrounding muscular layers are pale, discolored and readily torn.

In more diffused localizations of glanders there are found the alterations peculiar to erysipelatous and phlegmonous processes, either a simple swelling and œdema of certain parts, beneath which are situated small nodules, varying in size and filled with reddish pus, or in the same diffused forms there may be seen purulent infiltrations of the skin and the cellular tissue, especially upon the forehead and eyelids, and in the vicinity of the joints.

Upon the whole, there is manifested in glanders, as seen in the human subject, a relatively slight tendency to the development of tumors, as has been remarked by Virchow (Geschwulstlehre II. p. 552), although even the cutaneous pustules are formed from tubercles in the substance of the *cutis vera.*

The contiguous parts become involved in the diseased process; for instance, if the disease is situated upon the head, the bones of the skull and face, and more frequently the frontal bone, are affected, becoming often necrosed; while even upon the inner surface of the skull, between the bone and the *dura mater*, purulent collections may be formed (*pachymeningitis externa*). In other cases tubercles may appear in the periosteum of the skull, in the *dura mater*, and even in the *plexus choroides.* Virchow is therefore justified in speaking of an *osteomyelitis malleosa.*

In the nose, alterations are found in the human subject quite similar to those seen in the horse, although in many instances indeed no discharge has been observed during life. The small papules are of a yellowish color, and are seated upon the mucous membrane, the appearance of which is changed by the catarrhal and inflammatory processes. At the same time ulcers are formed, which, when the disease is prolonged, may attain a considerable size, presenting, for the most part, an irregular outline. The cartilage becomes exposed and necrosed, after the malady has lasted a certain length of time, and the same changes take place in the adjacent bones, so that we may find the septum, the vomer, and the palate bone disorganized, precisely as in the case of the horse. The neighboring submaxillary glands are generally enlarged and swollen.

In the *frontal sinuses*, the *pharynx* and *larynx*, and in the *trachea*, are likewise frequently found papules and ulcerations, which lesions are found also—though in rare instances—even in the bronchi. The growths and ulcers in the larynx may lead to œdema of the glottis.[1]

The *lungs* may be either entirely free from disease or they may be the seat of tubercles, nodules, and specific inflammatory processes. Externally there are often seen subpleural ecchymoses; at other times small tubercles are found upon the pleura; less frequently the pulmonary abscesses are accompanied by pleuritis upon one or both sides.

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[1] According to *Hauff* (loc. cit.) the larynx was diseased in eleven out of thirty-five cases; that is, in 31 per cent.

When the lung is the seat of localized processes, there are found in the substance of that organ numerous tubercles, varying in size from a millet-seed to a pea, of a firm texture, and of a gray, yellowish, or reddish color; or, at other times, nodules are seen of the size of a pea, of a gray, whitish appearance, and of a firm, lardaceous consistence. In other cases an entirely different appearance is presented, one or two infarctions of the size of a bean being developed in one lobe, distinctly circumscribed, and of a dark-red color, in and around which lie small abscesses.

In the more *diffused forms of these specific affections of the lungs*, which, as in the analogous changes found in the lungs of glandered horses, may be properly termed the pneumonia of glanders (*pneumonia malleosa*), the nodules are larger, forming isolated hepatizations and abscesses. The lobular nodules and abscesses may be either confined to one lobe, or they may be scattered throughout the entire lung. It frequently happens that large sections of the lungs are found to be in a condition of gray hepatization and purulent infiltration, while the other portions are in a state of collateral hyperæmia.

Of the remaining tissues of the body, the *muscles* form unquestionably the most frequent seat of specific changes. According to Küttner (loc. cit., p. 572), the specific nodules are mostly situated in the biceps, the flexors of the forearm, the rectus, and the pectoralis, and finally at the point of insertion of the deltoid.

The *cartilages* and *bones* are often involved secondarily in the destructive action of the adjacent specific affections, the ulcers and abscesses. In rarer instances, the bones and periosteum are the primary seat of the specific growths and inflammatory processes.

In the *other internal organs* numerous ecchymoses are often found in acute glanders. Furthermore, a stomatitis is sometimes observed at the autopsy, due to an extension of the disease from the cavities of the nose and throat; and upon the mucous membrane of the pharynx, ecchymoses, redness, swelling, erosions, and foul ulcers are also found. Ulcerations are often seen upon the velum of the palate. In some cases a croupous exudation is found upon the mucous membrane of the mouth and throat. The mucous lining of the stomach is often the seat of numerous large ecchymoses, while in exceptional cases specific papular-shaped formations are found in the substance of this tissue (O. Wyss [1]).

The *serous* membranes are here and there affected with purulent inflammation, especially the lining membranes of the joints. The joints of the knee, hip, and hand are said to be particularly liable to be implicated in this process.

The *spleen* is generally enlarged, filled with blood, softened and liquefied, and of a grayish-red, or dark color. Wedge-shaped abscesses (possibly of a pyæmic character?) are in some instances observed.

The *liver* is usually greatly enlarged, often showing signs of fatty degeneration. In one case [2] there was observed, in addition to the specific hepatitis of glanders, gangrenous and ulcerative inflammation of the gall-ducts.

In the *nervous system* there are found, in addition to the rare instances of inflammation of the membranes of the brain, scattered abscesses in the brain substance, and also a form of diffused *myelitis malleosa*, attributable to infiltration.[3]

Among the less frequent concomitants of the disease may be also mentioned specific [4] tubercles and abscesses of the *glans penis*, *testicles* (*sarcocele malleosa*, Virchow), and *kidneys*, specific papules of the *choroid coat* of the eye, and furthermore, inflammation of the *parotid gland.*

The *lymphatic glands*, in cases of glanders in man, are affected far less frequently, and also to a much smaller extent than is the case with horses.

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[1] For the knowledge of this fact, and an inspection of his excellent microscopic preparations, I am indebted to the politeness of *Prof. Wyss.*

[2] *Sommerbrodt*, Virchow's Archiv, B. 31, p. 463, 1864.

[3] *Coupland*, Med. Times and Gaz., 1872, p. 373.

[4] Here and throughout the article in the sense of *peculiar to glanders.*—TRANSLATOR.

It is to be remarked in conclusion, that in cases of glanders, as seen in the human subject, the *entire process presents a strong resemblance to certain forms of pyæmia*, and under certain circumstances may be confounded with that affection; and furthermore, it should be carefully borne in mind that metastatic pyæmia may be superadded, as a final symptom, to previously existing glanders; thus tending to render the anatomical diagnosis difficult.

A microscopic examination of the morbid products of glanders gives a result very similar to that found in the horse. In addition to the tubercular eruption, there are diffused infiltrations and specific inflammations, all of which manifest a very great tendency to disintegration and the formation of abscesses. My own investigations and experience, with respect to the organs affected with glanders in the human subject, enable me not only to accede to, but to put even in a more emphatic form the statement of Virchow, that in the human subject the tendency to the formation of tumors is by no means one of the essential features of the malady. Out of a large collection of preparations I was hardly able to find one well-developed tubercle, whereas in the horse such formations can be detected without difficulty.

In microscopic sections it will be seen (O. Wyss) that the nodules of the skin are formed by a deposit of numerous round cells, of the character of pus corpuscles, in the upper portion of the corium, beneath the papillary layer. In a more advanced stage the papillæ are filled with pus cells, and become gradually disorganized; thus arises beneath the epidermis a small abscess, which may extend into the deep tissues. When large pustules have formed, their contents will be found to consist of pus corpuscles, while the surrounding tissue of the cutis appears to be infiltrated with cellular elements, or rendered cloudy by a deposit of fat globules.

Wyss found analogous changes in the mucous membrane of the nose, only more extensive in character. There are also seen in the subcutaneous tissue, as in the mucous membrane, larger caseous tubercles (from two to four millimetres in diameter), composed of small granules and granular detritus.

Diagnosis.

The diagnosis of glanders in the human subject is often difficult, especially in the early stage of the disease and where the previous history of the patient is incomplete. This is to be attributed to the comparatively rare occurrence of the disease, for, even at the larger cliniques, years elapse without a case being observed. The autopsy often gives the first clue to the character of the disease, as Virchow[1] illustrates in the report of a case, in this respect instructive (observed at Würzburg), in which the post-mortem examination of a patient, who had been under treatment for over six months, on account of ulcers of the extremities, led to the discovery of a regular epizootic prevailing among the tow-horses of the rivers Main and Saale.

While in cases of infection by the fixed contagium, in the early stage at least, the symptoms may possibly be confounded with those produced by inoculations with morbid matter or cadaveric poisoning, in infection by the volatile contagium the disease at the outset is hardly to be recognized. When the local phenomena, however, once appear,—the cutaneous exanthema in the form of pustules, blebs, abscesses, erysipelatous and phlegmonous processes—accompanied by rheumatic pains, nasal affections, and other constitutional symptoms, the diagnosis presents no longer any difficulties.

It is always of great importance to ascertain the *occupation of the patient*, and in cases of individuals who have much to do with horses, suspicions as to the existence of glanders can be readily confirmed or dispelled by elucidating the other circumstances under which the illness was contracted.

If the pain in the muscles and extremities is prominent and severe, glanders may always be confounded with *rheumatism* in its various forms, or if a high fever prevail, and the sensorium become decidedly involved, it may be mistaken for *typhoid fever;* in both cases, however, a careful observation and examination will soon enable the physician to form a correct opinion.

Finally, glanders may be confounded with *pyæmia*, when the fever is accompanied by chills, cutaneous abscesses, and a high fever. But inasmuch as chills are an exceptional phenomenon in glanders, there is small danger of a wrong diagnosis being made in consequence of this symptom. Practically, however, all this is of no great significance, as has been forcibly remarked by Virchow in enumerating other sources of error (infection by cadaveric poison *and other putrid substances*). It is likewise possible to confound glanders with malignant pustule, but the cutaneous pustules and tubercles differ entirely from the carbuncles of the latter disorder.

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[1] Die krankhaften Geschwülste, II., p. 553, 1864.

In cases running a *chronic* course, with moderate ulcerations of the nose and larynx, glanders may acquire a very strong resemblance to certain forms of *syphilis*, or, if the larynx and lungs form the principal seat of the eruption, to *tuberculosis*.

As in horses, so also in the human subject, and especially in chronic cases, the inoculation of animals might be resorted to as an aid to diagnosis, for which purpose goats and rabbits are preeminently appropriate.

Auto-inoculation was undertaken in one case by Poland,[1] who produced pustules with inflamed areolæ by implanting the purulent secretion of a locally diseased part in the skin of the same individual.

Prognosis.

Concerning the curability of glanders in the human subject, recent authors (Virchow and Korányi) appear to agree that the prognosis is exceedingly unfavorable. Although Virchow[2] reports some cases of cure, Korányi goes so far as to affirm that no case of recovery from either acute or chronic glanders has ever been authenticated; while to farcy, making allowance for diagnostic errors, he accords a comparatively favorable diagnosis.

Apart from the fact that glanders and farcy, as we have already endeavored to show, are, both in the human subject and in the horse, perfectly identical processes, the distinction between them being of a traditional nature, and not based upon any observed phenomena, it is also to be observed that the essential features of both processes are perfectly similar. The most that can be admitted is, that the so-called farcy in its initiatory stages may be more easily affected by therapeutical agents, and upon this account may make a more favorable show as regards the comparative rate of mortality.

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[1] Med. Times and Gaz., 1869, p. 297.

[2] Zoonosen, p. 418, 1854.

According to the results of my own tabulated statistics, I should be inclined to assign an *absolutely unfavorable prognosis to acute glanders only;* the *subacute* and *chronic forms* permitting a *relatively favorable opinion as to the termination.*

In 38 cases of acute glanders, recovery ensued in 1 instance.
" 7 " subacute " " " 2 instances.
" 34 " chronic " " " 17 "

From this it will be seen that recovery took place in chronic glanders in 50 per cent. In this connection, it should be remarked that in the 34 cases designated above as chronic glanders, are included not only cases of farcy, but also the most pronounced forms of glanders.[1]

Out of a total of 120 cases of glanders (including the above 79, differently classified according to their duration), that I have succeeded in finding, there were 28 recoveries, equivalent to 23 per cent.

Hauff (loc. cit.), out of 70 cases collected by him, was able to report but 8 recoveries, equivalent to 11.4 per cent. According to Küttner, cases of infection from a fixed contagium have a decidedly more favorable chance of recovery than such as are induced by the volatile poison.

In view of the above figures, we are able to pronounce the prognosis in acute glanders as unconditionally unfavorable, the result being almost invariably fatal, whereas, since in the subacute and chronic varieties of the malady, one-half of all cases terminate in recovery, the prognosis is far more favorable.

When the disease has continued for some time the prospect for recovery becomes decidedly favorable, and this point, in a therapeutic point of view, cannot be overestimated in importance.

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[1] The favorable character of these figures may possibly be explained in this way, that in addition to the material found in strictly medical literature, I succeeded in collecting from the veterinary medical journals a series of cases which will bear most critical examination, but which, coming under the head of milder and less interesting cases, are seldom reported by surgeons.

Treatment.

The inefficiency of all therapeutic agents in the treatment of glanders in the human subject renders *prophylactic measures* of great importance.

The most efficacious of these measures consists in *stamping out, as far as possible, both glanders and farcy in horses*, a procedure to which, from considerations of economy, the attention of state governments has for a long time been carefully directed.

Thus, efficient sanitary regulations, carried out by police authorities, the destruction of glandered animals, as well as of animals suspected of being thus diseased, are the principal resources at our command.

Experience has taught us that, in countries provided with a thoroughly drilled corps of veterinary inspectors, the number of glandered horses falls to the minimum. In the French army,[1] so long as the contagiousness was denied, and attempts at treatment undertaken, the loss in animals by this disease amounted to about four per cent., but when more correct views were entertained, it sank to two per cent. In Bavaria, where the total number of horses is estimated at about 400,000, the annual number of cases of glanders, taking the average of nine years, is one hundred and seventy-five, equivalent to 0.04 per cent.; in Saxony, estimating the average of ten years, 0.1 per cent.; in Prussia, 0.07 per cent. of the entire number of horses. Although absolute immunity from glanders is for the present scarcely within the bounds of possibility, we may, nevertheless, with the aid of properly qualified sanitary officials and stringent regulations, reduce very materially the number of cases, and at the same time render decidedly less the danger with which man is threatened.

All persons, who from the nature of their occcupations are brought frequently in contact with horses, especially hostlers, soldiers, and the like, should be made thoroughly acquainted with the contagious properties of glanders. Instruction should be especially given as to the precautions to be taken whilst having to do with glandered horses, or those suspected of being diseased. Careful cleansing and disinfection are to be enjoined after post-mortem examinations, as well as at the killing and slaughtering of suspected horses.

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[1] Compare previous statements.

From my own experience, I can add, in confirmation of the statement of Virchow, that by the most thorough cleansing, cauterization, and disinfection of small wounds and excoriations that have been inoculated with the poison of glanders, the danger of a transference of the disease to man, who, on the whole, manifests but a slight affinity for the poison, is not very great.

A systematic inspection will readily suffice to prevent the sale of the meat of glandered horses, and the consequent risk of infection incurred by those compelled to handle or prepare such meat. Notwithstanding the experiments of Decroix, previously referred to, I deem it essential that there should be a strict supervision of slaughter-houses, and particularly for the reason that attempts are often made to conceal the existence of the disease.

In the treatment of glanders in man, if an early diagnosis can be made, and the point of entrance of the virus can be discovered, the *energetic local destruction of the virus* is first of all indicated, either by excision or cauterization with concentrated nitric acid, carbolic acid, fresh chlorine water, or other caustics. Abscesses and tumors should be laid open as soon as possible by free incisions, and local antiseptic treatment (injections of permanganate of potash, or carbolic acid in solution, and applications of carbolic oil, in the proportion of one part to ten) should also be resorted to with the view of stimulating the healing process.

The experiments of Gerlach demonstrated that carbolic acid, as well as fresh chlorine water, has a decidedly destructive effect upon the virus of glanders.

In *extensive phlegmonous* and *erysipelatous processes*, applications of ice, leeches, and the internal use of laxative agents have been at various times employed with success.

In *ulcerations* of the nose, injections of creosote water or carbolic acid have been often successful; so likewise the local treatment with tincture of iodine or nitrate of silver.

Of the numerous agents administered at various times *internally* with favorable results—bichlorate of iron, iodide of sulphur, iodide of potash, Fowler's solution, arsenic with nux vomica, mercury, iodide of potash, and carbolic acid—the last two should be made the subject of further investigation.

Of the greatest importance is the *general régime*, which should be of a tonic, stimulating character. In this connection may be mentioned quinine in large doses, alcoholic stimulants, especially wine or strong beer, nutritious diet, which should consist chiefly of broth and animal food.

The acids, which are frequently administered; furthermore, the bitter agents, discutients, and purgatives afford little or no assistance.

In case of decided collapse, sinapisms and ethereal irritants are indicated, and have frequently produced favorable results.

ANTHRAX.

MILZBRAND. CHARBON.

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ANTHRAX OF ANIMALS.

History.

AMONG all the contagious maladies affecting animals, anthrax has been the longest known, since in the earliest records of all historical knowledge (Exodus IX.) we possess descriptions of devastating diseases of animals, which in all probability relate to maladies of the same type as anthrax. According to the thorough investigations of Heusinger, the Greek and Roman veterinarians describe anthrax of the domestic animals under the titles *Οιδημα*, *Sacer ignis*, *Gutta robea*, *Gutta renalis*, *Pustula*. The ancient Greek physicians also designated malignant pustule as *anthrax*, the Romans called it *carbunculus*, while the Arabians described anthrax, as affecting mankind, in a still more precise and detailed manner, as *Alshac, al Humrah, or Persian fire*. After the authors of the middle ages—from the fourteenth to the eighteenth century—had concealed the various forms of anthrax as different diseases under numerous names, it first became known, toward the end of the last century, that these manifold diseases were, in reality, only different forms of the same disease. The most notable services in this direction were rendered by Chabert[1] (1780), who, in his monograph, proved the similarity of the maladies, which until then had been considered as totally distinct. Even to-day—after nearly one hundred years—the classification and nomenclature adopted by Chabert is adhered to in all essential particulars, not only in France but also in other countries.

Although *the contagiousness of anthrax* was proved by the numerous observations of the eighteenth century (Audouin de Chaignebrun, Fournier, Bertin, Brugnone, Montfils, Glaser, Thomassin, Enaux, Chaussier, etc.), Kausch, in the beginning of this century, maintained its non-contagiousness in cattle. He endeavors to locate the essence of anthrax—which in every other respect, especially as to its pathological anatomy, he depicts in an admirable manner—in a paralysis of the pneumogastrics, granting, however, the infection of men and animals by means of blood, flesh, etc.

Next in order, valuable contributions towards the elucidation of this formidable scourge were furnished (more especially) by Larrey (1811), Remer (1814), Laubender (1815), Greve (1818), Gaspardin (1820), Glanström (1824), J. F. Hoffmann (1827–30), Carganico (1835), C. G. Hildebrandt (1841), Delafond (1843), who made anthrax of sheep (*maladie de sang*) the particular subject of his studies, located the especial seat of anthrax in the rennet stomach and in the intestines, and described it as being by nature an acute enteritis associated among other things with blood changes. Thus Delafond denies the contagiousness of anthrax, and finds the chief causes in an over-nourishment of the animal and in the chemical conditions of the soil. On the other hand, Gerlach (1845), in his exhaustive work on the sheep-plague (*Blutseuche der Schafe*), proved the identity of the latter with anthrax, established its contagiousness experimentally, and concluded that the contagious principle was volatile and of great tenacity. The immediate cause or the essence of the plague (he believes) consists primarily in a poisoning of the blood, which (poison) in idiopathic cases is derived from the intestine, but in cases due to inoculation makes its entry into the blood through different channels.

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[1] *Ph. Chabert*, Description et traitement du Charbon. Paris, 1780. It may be inferred how great a general interest in anthrax existed even at that time, from the fact that this work passed through not less than seven editions in the course of seven years, and was moreover translated into Spanish and Italian.

Heusinger in his classical work (1850) sets forth the results of his investigations—historical and geographical, as well as pathological—in declaring anthrax to be a *malarial neurosis;* the malarial poison primarily attacking the ganglionic nervous system. As a first result the vessels of the spleen become paralyzed, and the spleen perishes—hence the name *Milzbrand* (inflammatory death of the spleen), which should not be discarded; then follow similar vascular paralyses, local points of stasis, extravasations of blood and local points of death (*Brand*) in the different organs. In anthrax a contagious principle is developed, which assists largely in the extension of the malady, and exercises the same power as the morbid influence first originating the disease. The poison is conveyed away from the areas of local disease by the lymph, and especially by the blood-vessels. The seemingly different forms of the malady, as found upon animals and men, are essentially identical. Anthrax is primarily developed only in herbaceous animals, mammals, solipeds, ruminants, swine. All animals are, however, susceptible of contagion. These are Heusinger's views.

In relation to the *malarial nature* of anthrax, Virchow (1855) is in accord with Heusinger. He dwells upon the septic character of the disease, and is inclined to consider a specific ferment the cause of anthrax.

During the same year (1855) Pollender made known his discoveries, which instituted a new epoch in the study of anthrax. Pollender found—as early indeed as 1849—in the blood of cattle suffering from anthrax *a countless mass of fine rod-like bodies*, which, in figure and appearance, resembled vibriones, and in their microchemical behavior were seemingly of a vegetable nature. Independently of Pollender, Branell (1857) found the same little bodies in the blood of men, horses, and sheep which had died of anthrax. Branell found that these bodies, which he described as vibriones, were even present during life in the blood of the diseased animals; he believed them to possess diagnostic value, while Pollender considered the question of their derivation, origin, and existence to be an open one.

As soon as the investigations of Pollender and Brauell became known, the general interest was turned towards these peculiar structures in the blood, and a majority of the works which next appeared discussed the question of the nature of the rod-like bodies and their relation to anthrax. From a number of further experiments, Brauell arrived at the conclusion that the little rods appeared one, two, three, less often from eight to ten, hours before death—in very acute cases only a few minutes before final dissolution, while they were wanting in the blood of convalescing animals. Therefore Brauell concluded that the rod-like bodies furnished a sign of diagnostic and prognostic value; but, on the other hand, he denied that they constituted the poison of anthrax or were the carriers of that poison, since he could produce anthrax by means of blood which did not contain them.

Now, in turn, the most varied judgments were rendered concerning the rod-like bodies. They were considered by various authors as particles of fibrine, shreds of tissue, blood-crystals. Delafond thought them a kind of *leptothrix*. He declared himself, moreover (1860), to be entirely in accordance with Brauell, and confirmed nearly everything laid down by the latter, supporting himself by numerous examinations of blood.

On the grounds of his experiments, Davaine (1863) *pronounced the rod-like bodies to be bacteria*, later *bacteridia*, in order to distinguish them from the bacteria of putrefaction which are capable of motion. Since blood without these bacteridia is not infectious, the latter constituted (for Davaine) the poisonous principle, by means of which anthrax is propagated. The bacteridia are destroyed by decomposition, but when dried they may be preserved for many months.

From this time forward the divergence in the views entertained concerning the rod-like bodies constantly increased; indeed, the entire question was thrown into a confusion which it is difficult to depict. Instead of abiding by the results of the investigations of Brauell and Pollender—results the value and exactness of which are still recognized—all sorts of structures (blood-crystals, the bacteria of decomposition, little rolls of blood corpuscles) were looked upon and described as the anthrax corpuscle (*Stäbchen*). There can be no doubt that this confusion was greatly due to the exceeding smallness of the rod-like bodies, the presence of other very similar structures in the blood, and a lack of unanimity as to what really was, and what was not, anthrax.

The study of anthrax and of the rod-like bodies was brought into especial prominence in France as the question of the day, and was materially furthered by Davaine, who rendered important services in this direction.

Davaine found *in every case of anthrax that bacteridia were present, and that their appearance preceded the morbid symptoms.* With the disappearance of bacteridia (by decomposition) the contagiousness of anthrax blood ceases. The number of the little bodies in a single drop of blood was estimated by Davaine at from eight to ten millions, and he claimed to have produced anthrax by the millionth dilution of such a drop.

Among the numerous opponents of Davaine may be mentioned especially Sanson, Leplat, Jaillard, and Bouley, who severally contended that the rod-like bodies were merely the bearers of the contagion, since they are often wanting, and yet in such cases the blood, devoid of bacteria, possesses infectious properties.

Now, bacteria, which had been neglected by botanists, became in this aspect also the subject of zealous discussion. After the failure of Hallier's attempt to transform the whole doctrine of the lower fungi, and to vindicate for them a cardinal rôle in the doctrine of contagious diseases, de Bary, H. Hoffmann, and F. Cohn, in a very comprehensive manner, enlarged the foundations of our knowledge of these important structures, which had been laid by Ehrenberg and Nägeli.[1]

Henceforward bacteria, and among them our anthrax-bacteria, were classed along with the *schizomycetes* (*Spaltpilzen*, Nägeli), so named on account of their great friability. Although bacteria, especially those possessed of motion, were classed by certain zoologists (Schmarda) among animals (infusoria), or were placed (Häckel) in a third organic kingdom, holding an intermediate position between the animal and the vegetable kingdoms, with such organisms as the zoophytes, still the near relation of the *schizomycetes* to the lower plants, as shown by the results of more recent investigations, has been established, and their vegetable nature is of late no longer doubted by zoological authorities.

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[1] See *Bollinger*, Zur Pathologie des Milzbrandes. München, 1872, pp. 15–22, where an attempt is made to give a review of the bacterial controversy.

While, in relation to anthrax of the human species, we refer to some later and more special historical remarks which we shall make further on, we have still to call to notice here the results of our own investigations, which in all essential particulars substantiated the hypothesis of Davaine—according to which the anthrax bacteria actually represent the poison—and assisted in explaining their action upon the animal organism. Moreover, the contradictory statements of the earlier investigators have now been set at rest by the microscopical and experimental proof of the existence of bacterial germs.

Etiology.

Anthrax is an acute infectious malady, which breaks out commonly in an epizootic or enzootic manner, and is not infrequently sporadic in herbivorous animals and swine. It is transmissible to a great number of other animals, as well as to mankind.

Local peculiarities of soil play an active part in the development of enzootic anthrax. While the inorganic constituents of the soil are by just so much of significance as they hasten or retard the decomposition of the organic material, the amount of the latter exercises a very positive influence. Anthrax is chiefly found on soils rich in decaying vegetable matter—on peat-moors, in the vicinity of dried-up water-courses and lakes, on freshly upturned soils, and especially where intermittent fever also flourishes (anthrax-districts).

An unusual amount of *decaying vegetable* matter in the soil.

joined with an excess of *moisture*, appears to furnish the most favorable conditions of life for the poison.

But still weighty objections may be urged against the commonly adopted theory of the malarial nature of anthrax. The latter, for instance, does not by any means always hold a course parallel to other malarial maladies—intermittent fever. In many anthrax districts intermittent fever is wholly unknown; while on the other hand, in localities where the latter is prevalent, there is no anthrax. Then, again, in large anthrax districts, small areas may be separated out which possess a total immunity from anthrax, or where the cases observed may be especially numerous. It may be assumed for anthrax, as well as in the case of certain other infectious diseases, that only such soil as is impregnated with the anthrax poison, causes the disease; and that it does so as soon as it is in a favorable condition for the preservation and development of the virulent material; while, on the other hand, on the same soil, if there be no anthrax-poison present, the disease never develops there.

In support of this assumption, which has been recently insisted upon by Nicolai,[1] who endeavored to actually prove it, the following observations may be adduced. Oemler[2] (Mansfeld) reports that in one year, after he had most positively forbidden the interment of all cadavers, without exception, in his fields and meadows, his loss of sheep from anthrax sank from 21 to 2 per cent. Leonhardt[3] reports from the Nidder- and Niddathal in Oberhessen, where anthrax is enzootic, that in Bönstadt, which suffered severely from the disease, the latter almost entirely disappeared among cattle, and finally, was nearly forgotten, after the sheep had been carried away. It had been usual for numbers of these sheep to perish of anthrax during the summer, and their bodies had either not been interred at all, or had been only imperfectly buried in the fields. On the other hand, in certain places lying in the immediate neighborhood, Assenheim and Florstadt, where there were still sheepfolds, anthrax raged with unabated severity, manifestly because there the sheep which died of anthrax were (as formerly in Bönstadt) either imperfectly buried on the spot, or thrown aside among the grass and growing grain. The commission appointed by the Russian government to investigate the causes of the anthrax enzootics occurring in Russia, reported as one of the most important points of origin of the epizootics, that the horses which were used for towing boats on the Scheksna frequently died of anthrax, and that their bodies were improperly disposed of. They were not ordinarily buried at all, but befouled the air and the water of the stream, which latter, moreover, ran through a swampy region (Massmann).[1]

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[1] *Nicolai*, Erfahrungen und Notizen über Milzbranderkrankungen bei Mensch und Thier., p. 25. Darmstadt and Leipzig, 1872.

[2] Zeitschrift des landwirthsch, Centralvereins der Prov. Sachsen, 24 Jahrg., No. 6, 1867.

[3] Zeitschrift für die landw. Vereine des Grossh. Hessen, 1870, p. 68; also a communication by letter to the author.

Certain physical conditions of the soil, moreover, are of great influence in the development of anthrax—such as the amount of water it contains, and its temperature. Thus a considerable drying up of the soil seems to prevent the escape of the miasm. When this crust of surface soil, which has been rendered impermeable by great heat, is destroyed by a return of rainy weather, the number of cases of anthrax increases; while, on the other hand, upon a soil saturated with water, the cases of anthrax become more frequent when, on the advent of warm weather, large quantities of water are evaporated (Nicolai). As to thermometrical local conditions there can be no doubt—from a comparison of the conclusions of Korányi, Lengyel, and Nicolai —that even among men anthrax reaches by far its greatest intensity in those months in which the temperature of the soil attains its maximum: these months are, according to the investigations of Pfeiffer, August and September.

That the soil and local conditions are among the chief factors in the development of anthrax is, then, hardly to be doubted. This question alone needs an accurate solution, namely, *whether it is necessary that the soil shall be impregnated with the poison, or whether it is able to generate the poison spontaneously.* The fact that anthrax was formerly a common malady (for example, even in Switzerland), and was of much more frequent occurrence than to-day, admits of various interpretations. While, on the one hand, a large share in the lessening of anthrax is ascribed to a more thorough cultivation and a steadily progressive tilling of the soil, the transformation of dangerous meadow lands into arable territory (Wald): on the other hand it may be urged that the improvement is (not improbably) due to the more thorough and intelligent disposal of the bodies of animals which have perished of anthrax.

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[1] Deutsche Zeitschrift für Staatsarzneikunde, Heft I., 1869.

Regarding the influence of stagnating water, here also there exist some well-attested facts.

Buhl[1] reports that the "horse typhus" (a form of anthrax), which raged for a long time in the Neuhof stud at Donauwörth, ceased entirely after the stagnating water had been drawn off—following the advice of Pettenkofer. Reinelt[2] states that in the Biharer district anthrax, which had been very common, nearly ceased to appear after the river Theiss had been cleared. According to Wald (l. c., p. 53) in many of the districts lying around Potsdam, anthrax, which at one time had been common there, gradually disappeared, after the swampy land had been dried up by extensive improvements and drainage, and a suitable outlet had been furnished for the stagnating water. In this way the over-saturation of the soil was relieved.

It is wholly unproved whether or not a *manuring of the soil with certain mineral substances* (gypsum, sulphates)—which favor the decomposition of its organic constituents—is capable of originating anthrax in districts till then exempt. Toward elucidating this point it would first be necessary to decide whether artificial manures—and especially bone-dust,[3] which is quite frequently employed as a fertilizer—may not perhaps act as vehicles of contagion.

If now we seek to explain the bearing which the state of the soil has upon the existence of anthrax, and are inclined (following a course somewhat different from that pursued by the majority of former observers) to attribute to the soil something like the rôle of an *intermediate bearer of the anthrax poison*—which it only preserves and holds in a condition capable of life—still other arguments may be adduced to support our view.

It is a recognized fact that anthrax is markedly stationary, or occasionally appears in an enzootic form in places where the bodies of infected animals, or indeed only certain portions, as the blood, are disposed of in a faulty manner. In this way I account for the obstinate and enzootic appearance of anthrax upon certain Alpine pastures (so-called anthrax Alps), for there the bodies of animals perishing of anthrax are often simply thrown to one side among the cliffs and out-of-the-way places, on account of the lack of hands necessary for a careful burial. The truth of this assumption is made more probable by the above detailed observations of Oemler and Leonhardt, and finally it is substantiated by the anthrax enzootic at Werikon, which I thoroughly investigated and reported. Here for more than four years continuously, in two stables belonging to the same owner, anthrax decimated the stock of cattle, while the yards were spared, although lying partly between the infected stables; thus showing that under certain circumstances, even where anthrax rages as an enzootic, the soil may remain without any share in the infection although the stables are involved. The final deductions of Nicolai—a thorough and experienced observer, whose rich experience was derived from observations in a very positively marked anthrax district—ratify the conclusions which I adopted in connection with the anthrax enzootic at Werikon, namely, that contagion, and indeed mediate contagion, is one of the most important sources of anthrax.

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[1] Zeitschrift für Biologie, B. I., 1865.

[2] Oesterr. Vierteljahrsschrift f. wiss. Veterinärkunde, B. XXXI., p. 111, 1869.

[3] The preparation of raw bone meal—which is employed by preference as a fertilizer by farmers—does not destroy the anthrax poison, when the bones are taken from infected animals.

Hence, as a matter of course, climate, geographical position, altitude above the sea, weather, and other influences—such as the nature of the fodder, the keep of the animals—although they have severally been blamed as so many causes of anthrax, are totally denied as such. On the other hand, the conditions of earth and air, of place and time, are certainly of the greatest significance as auxiliary causes, as for example the amount of dew, the temperature of the air, the varying amount of moisture in the soil (ground-water), the temperature of the soil, the movements of the lower atmospheric strata.

The chief source, then, of anthrax is contagion. This, however, is seldom direct, but is usually brought about through the instrumentality of mediate agents; the specific poison of anthrax is transmissible in a high degree.

Consequently anthrax is not contagious like small-pox. It approaches more nearly to pyæmia and septicæmia, and even—though only to a certain extent—to cholera and typhoid fever.

If we inquire what material is most frequently the carrier of the poison of anthrax, the diseased and dead animal, in all its parts, deserves the first mention. Most frequently the fluids of diseased animals are to be blamed (blood from blood-letting, blood which in the slaughtering, cutting up, and burying of animals adheres to everything it touches and quickly dries up); then the hides, hair, bristles, hoofs, horns, bones, flesh, secretions, excretions—especially the excrement—all of these are to be feared as vehicles of contagion.

Further, as carriers of the poison must be mentioned healthy animals and men, who themselves for some reason do not become sick (perhaps on account of lack of aptitude for the malady). In this class belong flies, which are particularly dangerous as carriers of the poison.

Gerlach, l. c., reports the transmission of anthrax by dogs as inoculators. When the shepherd dogs are called away from their meal—devouring the bodies of animals destroyed by anthrax—and used for getting the flock together, the sheep which are bitten perish in two or three days of anthrax. By some observers (Davaine and Raimbert) all cases of anthrax which cannot be explained by direct contagion are attributed to inoculation by flies. That this hypothesis is untenable is shown at once by the fact that the disease continues its devastations through the winter when there are no flies.

Davaine obtained positive results by inoculation with the proboscis and feet of flies, contaminated with the blood of diseased animals, and thus founded his theory experimentally. According to Raimbert's investigations flies which sting by means of a sting situated in the back part of the body are without danger, although such stings often give rise to a bad sort of furuncle. On the other hand, those flies (house-flies, blue-bottle flies) which live upon flesh and blood, carry the poison on their feet, wings, and in their dejections, and by depositing it on the uninjured skin produce anthrax. I communicated some similar results to the gathering of naturalists at Wiesbaden (1873): the contents of the stomach and intestines of horse-flies, which I collected from the body of a steer which had just died of anthrax, showed the well-known bacteria, and inoculation upon two rabbits produced the disease. In the same manner I demonstrated experimentally the virulence of the milk and vaginal mucus of diseased animals, although, according to the experience of other observers (Cauvet), the milk of animals suffering from anthrax may frequently be taken without injury.

There must be mentioned further, as carriers of the contagion, the harness of animals, implements used in stables, straw, hay, all objects which come into contact with sick or diseased beasts (their blood, mucus, etc.), and thus become soiled. Earth—especially when loaded with vegetable matter in decay—is marked by the special facility with which it preserves the contagious material—perhaps also by a power of reproducing it—and that through a period of years.

The propagation of anthrax by means of food, particularly coarse fodder, is especially frequent. The greatest blame is bestowed upon such fodder as grows in places where the bodies of animals which have died of anthrax have been buried, and many believe that, in these cases, the plants themselves act as bearers of the poison. There is as yet no proof of the truth of this assumption. In my opinion, in these cases, the earth adhering to the plants seems to act as the vehicle of contagion,—earth which was contaminated at the time of burial of the animals—for the body itself very soon loses its specific virulence after it has been buried, as I have been able to prove experimentally (l. c., p. 86).

According to the investigations of Renault, Colin, and myself, animals not disposed to acquire anthrax (carnivorous, omnivorous, birds) may eat raw portions of diseased animals without injury, while herbivorous animals (sheep, horses, goats) are more liable to infection in this manner, as are also rabbits.

Moreover, when the fodder comes into contact with any infected matter—especially with blood which has been dried in the air—it is capable under certain circumstances of again producing anthrax. Likewise drinking-water may act as a source of infection by trickling through infected soil or by direct contamination with diseased matter. Stable drainage seems to be less dangerous, since the poison is destroyed by decomposition. The customary medium of communication for anthrax poison is, however, the air, whether the carriers of that poison (anthrax bacteria) come out of the soil or are derived from living animals. The digestive tract holds the second place. Here the poison enters the body with the food. Even in those experiments which gave positive results where food was used, as well as in the frequently recognized infection after voluntary feeding on diseased meat, the possibility must always be borne in mind, that either before or during feeding (by smelling or snuffing at the infected material) the light and movable poisonous matter might have been drawn into the lungs, and thus reached the blood and animal fluids; or indeed, during feeding on contaminated matter.

the poison may directly inoculate pre-existing injuries of the mouth or throat. Accurate experiments have proved (Colin, l. c.) that the gastric juice of carnivorous animals is capable of destroying the poison.

For the existence of anthrax, however, in whatever way the infection occurs, an *individual susceptibility* is necessary, depending partly upon the species of animal and partly upon unknown factors. While herbivorous animals (cattle, sheep, goats, and horses)—as also grass-feeders in the wild state (roe, stag)—are noticeable for their great susceptibility, the latter is less marked in omnivorous animals (swine, men), and is least pronounced in the carnivorous, among which the cat acquires the disease more readily than the dog.

Age and sex are without influence; not so the keep and nourishment of the animals. Just as in the parasitic infectious diseases of the vegetable kingdom, where the fungus attacks perfectly healthy plants, indeed, where the parasite seems to flourish so much the better as the plant which nourishes it thrives,[1] well-nourished animals fall victims to anthrax by preference. Hence, animals which have been recently introduced, brought from stables and districts free from the disease, are more frequently seized by the malady than such as have long remained in the infected stables and districts. Animals which are turned out upon the fields in the anthrax districts are more apt to receive the poison than such as are kept in stables. Other infectious diseases (*e.g.*, inoculated tuberculosis) do not afford immunity from anthrax.

NATURE OF THE ANTHRAX POISON.

Although the first discoverers of the anthrax bacteria (Pollender and Brauell) had declared it possible, that the latter might bear some relation to the genesis of the disease, yet Brauell entirely abandoned this idea on the ground of his experimental researches.

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[1] *De Bary*, Handbuch der Physiol. Botanik von Hoffmeister, B. II., p. 222, 1866. Formerly exactly the opposite idea prevailed, namely, that lack of health on the part of a plant was most favorable for a development of the vegetable parasites.

Brauell[1] produced anthrax in two foals by inoculation with blood which did not contain any rod-like bodies, while the blood of the inoculated animals showed them. From this he drew the deduction that these structures were neither the contagious material nor the necessary carriers of the same. Bouley[2] failed to produce anthrax by inoculating with the blood of infected animals which contained no bacteria. These experiments, which were also verified by me (l. c., p. 49), constituted the most powerful argument which could be raised against the theory of Davaine, according to which the bacteria represent the specific anthrax virus. It is easy to conceive that bacteria in the blood and organs of diseased animals may be easily overlooked on account of their smallness, especially if they are few in numbers and scattered, that investigations of blood are frequently not carried on with sufficient thoroughness, and that bacteria, when they exist only locally in the body, may remain unnoticed. This I have proved experimentally and by the microscope, showing that in infectious blood of this kind, without bacteria, the germs of the latter are already present in the form of spherical bacteria[3] (l. c., p. 48 et seq.) Indeed, I succeeded, by the inoculation of diseased blood containing bacteria, in producing true anthrax in which the blood of the diseased animals contained no bacteria, although there were bacterial germs which, after death, developed outside of the body into characteristic cylindrical bacteria (l. c., p. 67).

After Davaine's assertion, that blood without bacteria was incapable of producing anthrax, had been thus refuted, the results of fresh experiments again pronounced strongly in favor of Davaine's theory. Brauell[4] had already established that blood without bacteria, derived from the embryos of mares and sheep suffering with anthrax, and inoculated upon foals and sheep, did not cause the disease. Davaine[1] arrived at the same results, making use of pregnant guinea-pigs.

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[1] Virchow's Archiv, B. XXXVI., p. 463, 1866.

[2] Recueil de méd. vét., Vol. XLVI., p. 41, 1869.

[3] It has of late been again brilliantly demonstrated by *G. W. Müller* (and *Schuster*) that it is possible to produce true anthrax with filamentous bacteria, by the inoculation of diseased blood containing spherical bacteria (bacterial germs), but no filamentous bacteria.

[4] Virchow's Archiv, B. XIV., p 459, 1858.

Thus while all efforts to isolate anthrax bacteria by filtration with ordinary apparatus (filter-paper, earthen cylinders) have thus far failed, yet the placenta appears to be a physiological filter, not allowing the bacteria to reach the fœtal circulation. On the other hand, the results of inoculation speak strongly in favor of the virulent properties of the bacteria. *Fœtal blood without bacteria does not produce anthrax, while inoculation of the blood of the mother which does contain bacteria gives positive results.*

From the almost constant appearance of characteristic bacteria (or bacterial germs) in the blood of the diseased animals, and in view of the results of inoculation adduced above, and the exquisite character of anthrax as a blood disease, it appeared proper to consider these little organisms as the anthrax poison itself, provided we could explain the clinical and anatomico-pathological appearances from their peculiarities and behavior.

When Davaine endeavored to explain the whole course of a disease, the anatomical changes of which are so important, chiefly by a cohesiveness of the blood-corpuscles leading to obstruction of the smaller vessels, it was at once evident that this basis was not sufficiently broad to explain the disease thoroughly, or for the physiological elucidation of the appearances during life.

Should it now be asked, *What is the action of the bacteria and similar structures upon the bodies in which they dwell?*—relying upon modern investigations a comprehensive answer may be given.

Pasteur, in his search into the requirements of life of the bacteria, arrived at the result that their existence was dependent upon the presence of oxygen, and on this account called them Aërobia. By the action of schizomycetes (bacteria and vibriones) a rapid oxidation takes place in organic bodies, the products of which are water, carbonic acid, and the more simple organic compounds. The oxygen, of which the fungi absorb a considerable quantity in this process, they extract from the air when the latter has free access to them, otherwise from the organic substance itself. H. Hoffmann and F. Cohn have also conclusively proved that the life and growth of bacteria is dependent upon oxygen, which they greedily absorb. Without oxygen bacteria cannot live. When it fails, they are arrested in their growth, or die.

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[1] Recueil de méd. vét., 1868, p. 199.

The serious objection, that it is *à priori* inadmissible to bestow the physiological peculiarities of the saprogenic bacteria without question upon those which are seemingly pathological, appears to me to be answered by one of the earlier experiments of Davaine.[1] By sealing up anthrax blood in five glass tubes, to the entire exclusion of air (and consequently of oxygen), the bacteria died in a few days, and inoculation with such blood would not produce anthrax.

By deductions from numerous experimental, clinical, and anatomico-pathological results, I believe that I have adduced the proof (l. c., p. 132) that the action of anthrax bacteria—(which are present in enormous numbers[2] in the blood of the domestic animals suffering from apoplectiform anthrax, which is very common)—is apparently this: the bacteria, by their rapid increase in the blood, by virtue of their powerful need for oxygen, and their enormous chemical affinity for the same, absorb it with great greed and in large quantities, thus taking it away from the red blood-corpuscles. All the symptoms of the sick animals while alive—dyspnœa, cyanosis, clonic spasms, dilated pupils, finally, depressed temperature and the appearance of asphyxia—all of these symptoms, as in every case of carbonic-acid poisoning, are explicable by the above detailed mechanism which quickly results in a lack of oxygen, and an excess of carbonic acid in the blood. Likewise the post-mortem examination reveals changes similar to those which we are accustomed to find after death due to lack of oxygen and overloading of the blood with carbonic acid—engorgement of the venous system, dark, tarry character of the blood, slight hemorrhages in different organs, cyanotic coloring of the parenchymatous organs, hyperæmia of the lungs. The overloading of the blood with carbonic acid is, moreover, greatly increased on account of the active oxygenation which is going on, yielding a further quantity of carbonic acid as the product of combustion. In this manner I explain those lightning-like and apoplectiform cases where the animals suddenly sink to the earth and promptly expire. These forms of anthrax are very common. In their course and in their whole pathology they find their analogy in no spontaneously existing process of disease, but offer the greatest similarity to poisoning by hydrocyanic acid. Death by this poison is, according to Preyer, in fact a death by suffocation, on account of the withdrawal of the oxygen by the acid; therefore I place the lightning-like action of the bacteria in such cases in the same rank as poisoning by hydrocyanic acid. In discussing the anatomico-pathological changes of anthrax, we will return to this question, and see to what extent the other cadaveric changes may be explained by the action of the bacteria, which is, moreover, partly mechanical.

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[1] Journ. des Vetér. du Midi, T. VII., p. 444, 1864.

[2] Davaine estimates the number of bacteria in a drop of anthrax blood at from eight to ten millions.

In those cases of anthrax which run a slower course, and in those rare forms where the blood contains only the bacterial germs, apparently other chemical poisons are secondarily produced in the blood, and furnish a cause for the fever and other symptoms.

The *morphological peculiarities* of anthrax bacteria may be characterized as follows:

According to Cohn's[1] recent systematic classification of bacteria, anthrax bacteria belong to the group known as *filamentous bacteria* (desmobacteria) and to the species *bacillus*. The *bacillus anthracis* (Cohn) is closely related to the *bacillus subtilis* (*Vibrio subtilis*, Ehrenberg), to the butyric acid ferment (*ferment butyrique Pasteur*).

Bacilli, such as are almost constantly found in the blood of animals suffering from anthrax, possess the following morphological peculiarities. They are straight, less often bent or with obtuse angles, indented cylindrical rods of pale appearance, never branched, motionless, generally 0.007–0.012 mm. long, and of a breadth which is hardly measurable. Besides these well-pronounced filamentous bacteria, smaller transitory forms may be found, although fewer in number, 0.002, 0.003, and 0.005 mm. long, down to the very smallest forms which cannot be measured, and which, when viewed with ordinary glasses (Hartnack 7.3[1]) appear as fine points, while with higher powers they are seen to be spherical bacteria, with all the optical and chemical peculiarities of the filamentous bacteria.

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[1] Beiträge zur Biologie der Pflanzen, II., p. 173, 1872. Cohn has not personally studied the anthrax bacilli. He has arranged them according to the description given by Davaine and myself.

Larger bacteria, which exceed the measurement above given, are very rarely found, and those of 0.050 mm. length, as described by Davaine, have been only once observed by me, and perhaps then they were rather to be considered as post-mortem products. With medium and low magnifying powers (Fig. 8), the filamentous bacteria appear without joints and homogeneous.

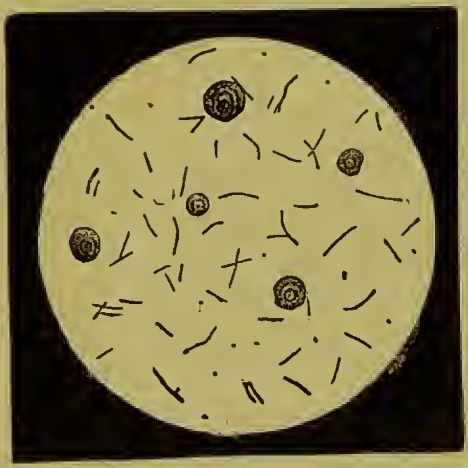

FIG. 8.

Fresh anthrax bacilli, from the blood of a cat which died of anthrax after inoculation. (Case XXII., l. c.) Hartnack 7, 3, × 320.

With higher powers, and by employing artificial means (causing them to swell by soaking in water), it is seen that the filamentous bacteria are formed of different members, and are in fact constituted by a juxtaposition of round or short cylindrical cells (Fig. 9).

The isolated spherical bacteria may also be found alone in the blood of anthrax. They grow continually by scission, and, as little rows of cells united together, constitute the rods (filamentous bacteria) which grow symmetrically at all points by scission. The little rods, which in the fresh state seem homogeneous, after they have been swollen by water and then dried, exhibit an envelope and a plasma. Anthrax bacteria are distinguished from other bacteria (bacteria of decomposition, as found in animal or vegetable infusions, bacteria of sour milk) particularly by the fact that they have a certain symmetry of form and appearance, and are devoid of motion. Otherwise their behavior with reagents is exactly the same as that of the above-mentioned varieties, and they are noticeable for their great resistance to concentrated acids and alkalies.

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[1] Objective No. 7, ocular No. 3.—TRANSLATOR.

The varied descriptions of bacteria, as given by authors, may be mostly explained by the fact that the bacteria of decomposition and other post-mortem products (blood-crystals) have frequently been mistaken for anthrax bacteria. Whether the latter are capable of motion in the blood of living animals is as yet undecided. I did not succeed in giving them motion by artificially warming the blood.

The development of anthrax bacteria is dependent upon the presence of oxygen. By being dried they may be preserved, but

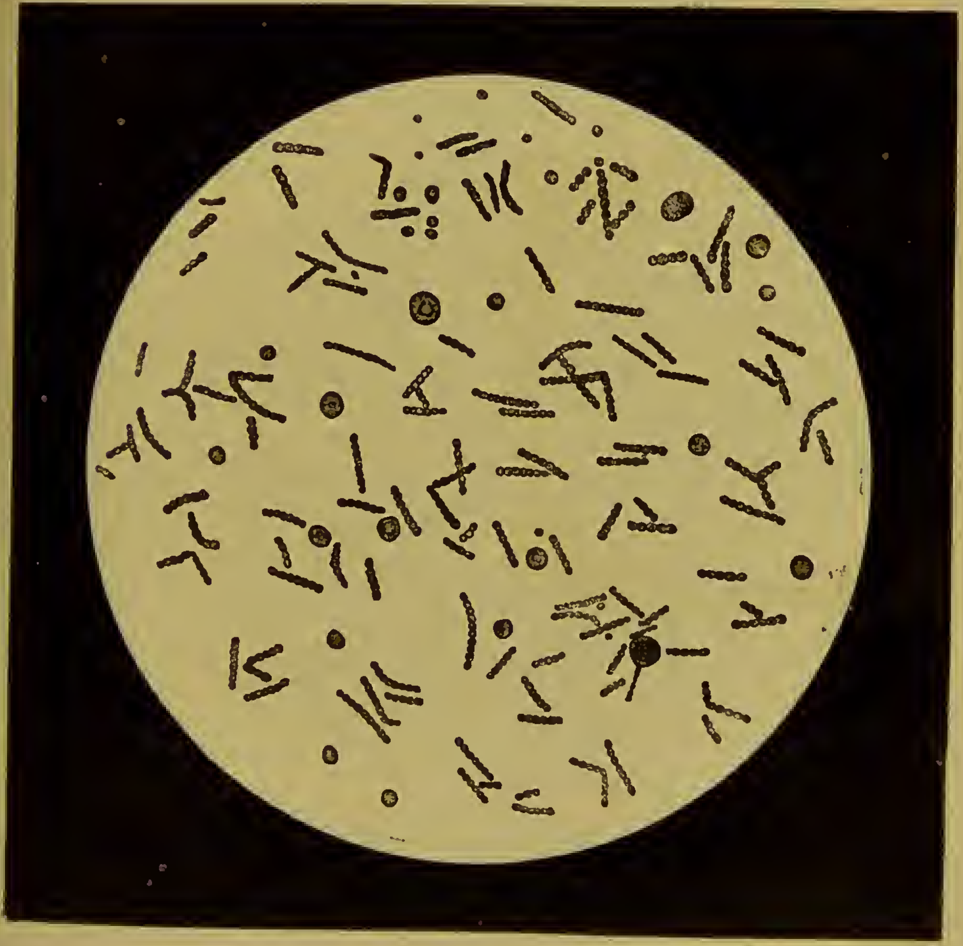

FIG. 9.

Anthrax bacteria from the blood of a steer which died of apoplectiform anthrax (Case XII., l. c., 26, II., 1872). The segments made plain by artificial swelling (with water). Drawn from a fresh preparation, two days after death. by E. Jager (of Brugg), student. Hartnack 9, oc. 3, × 550.

decomposition rapidly destroys them. With their departure, and the appearance of bacteria of decomposition, disappears also the virulence of anthrax blood. The disease is no longer produced by inoculation of the fluid, which is either negative or gives rise to putrid infection. Anthrax bacteria are deprived of their power of development by cooking, or by the action of a temperature of 140° Fahr.

Davaine states that fresh anthrax blood, after remaining ten minutes in a glass tube in boiling water, continues to be infectious. According to investigations recently instituted, anthrax blood loses its virulence after being cooked for five minutes. Rabbits inoculated with such blood remain well, while the same blood before being cooked produces fatal anthrax by inoculation.

On the other hand, bacteria are apparently not destroyed by very low temperatures, as low as—1° Fahr. maintained for several hours. According to the investigations of Cohn, they become dormant at 32° Fahr., like other (saprogenic) bacteria, and seemingly even at a somewhat higher temperature. Under the influence of cold they lose certain physiological peculiarities (growth, action on foreign substances), not, however, the power of recovering their development at a higher temperature. Moreover, bacteria are destroyed by solutions of carbolic acid, chlorine water, and similar disinfectants.

Unfortunately our knowledge of the behavior of anthrax bacteria in the living body is very limited. It is certain that they may appear locally, or be unevenly distributed (which partially explains their frequently alleged absence); and further, it may be concluded from the clinical and anatomico-pathological bearing of many forms of anthrax (horse-typhus), that they may disappear from the body, as I have endeavored to explain elsewhere (l. c., p. 131).

From the intermittent character of anthrax, which is frequently observed (see my work, Case X., p. 32 and p. 94), and the paroxysmal nature of the symptoms, it is certainly allowable to assume a corresponding appearance of bacteria in mass, and a gradual disappearance of the same. In this way a coincidence of the bacteria with the attacks would take place analogously to the appearance of the *recurrens-spirochæte*, recently discovered by Obermeier.[1] Moreover, it has been proved by numerous injections of fungus into the blood of living animals, as well as by the injection of blood containing bacteria into the veins of a dog (see l. c., Case XXXIX., Inoculation 13, p. 86), that the living animal organism has the power of ejecting blood parasites of this kind, or at least of causing them to disappear.

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[1] *Prof. Cohn* (in Breslau), in a communication by letter, is inclined to accept this theory.

How anthrax bacteria or their germs get into the body may be imagined without difficulty by recalling the common characters of these organisms. Whether they originate from the soil, or, becoming dried up, as the remains of a case of anthrax, adhere to some object, sooner or later they get free by some mechanical influence, or by accidental contact become mixed with water. Small and light, they are wafted by the breeze, and either directly breathed in by the animal, or they fall upon the fluid or solid food, and with it enter the body. Such bacterial germs suspended in the air may be washed down by rain, conveyed to a distance and deposited in any place whither chance may carry them.[1] The penetration of anthrax bacteria through the loose and thin mucous membranes of the animal body is easy to comprehend, in view of their minute size and of the fact that even hard substances (egg-shells) oppose no obstacle to the passage of analogous substances, as well as finally of this fact, that bacteria of decomposition, after death, penetrate immediately from the cavity of the intestine (and with great rapidity) into the organs of the body, and spread themselves in all directions.

The tenacity of the anthrax poison—bacteria—is exceedingly great. In the dried state the bacteria are able to preserve their virulence during months, and even many years.

Davaine succeeded in producing anthrax by inoculation of dried anthrax-blood twenty-two months old. Einike[2] relates the following case as very well illustrating the virulence and tenacity of the poison. The skin of an ox (from whose flesh two persons got carbuncle), which died of anthrax in the fall of 1852, was soaked in the following spring in the water of a pond, and then made up by a saddler into harness. The saddler got carbuncle. From a flock of sheep which were washed in the pond four weeks later, twenty perished in a few days of anthrax, and both of the horses (for whom the new harness was made), after they had worn it for four days, died of the disease in forty-eight hours.

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[1] It is noticeable that similar ideas prevailed in the olden time concerning the origin and spread of anthrax: "Take you handfuls of ashes of the furnace, and let Moses sprinkle it toward heaven in the sight of Pharaoh, and it shall become small dust in all the land of Egypt, and shall be a boil breaking forth with blains upon man, and upon beast" (Exodus IX., 8-10). The peculiar belief existing in North Sweden in the last century, that a fabulous animal dropping out of the air caused anthrax, was so deeply rooted that *Linnæus* and *Solander* received it into the zoological system as *furia infernalis*, and later it was retained in its position by *Pallas*.

[2] Mittheilungen aus der thierärztlichen Praxis im preuss. Staate, 1855.

Hence, anthrax may be characterized as follows:

Anthrax is an acute infectious disease. The infectious material consists of a vegetable parasite, which is produced in the diseased animals (endogenous), and perhaps also finds the conditions adapted to its development outside of the same, namely, in the soil (ectogenous);—it being understood that the soil has been previously impregnated with these organisms or their germs. Anthrax is not contagious in the ordinary sense of the term, since an immediate contagion from animal to animal has hardly been proved. It is, however, in a high degree transmissible (mediate contagion), since the anthrax poison may be preserved for a long time, and transported by numerous mediate objects.[1] The poison, which although a fixed one, is also diffused through the air, most often enters the body through the lungs, but perhaps also it gets in with the food and drink.

Appearance and Spread.

We have shown above that the herbivorous animals are particularly liable to acquire anthrax, that the susceptibility is less in the omnivorous, and least of all in the carnivorous. Indisputably the disease appears most often among the domestic animals, —cattle, horses, sheep—the ass and the goat being less often attacked. Swine also suffer, although much less often than is commonly believed. They are subject to a scourge which is frequently, though falsely, reckoned as anthrax, and is indeed similar to it in many of its features, and equally dangerous—the hog-plague (Rothlauf, *Schweineseuche*, *mal rouge*). Anthrax is very easily communicable (by inoculation) to guinea-pigs, with more difficulty to dogs and poultry, somewhat more easily to cats.

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[1] While *Davaine* maintained the non-contagiousness of anthrax, yet he evidently drew his conclusions from considerations similar to those here advanced, and only erred in that as a counterpart he set up septicæmia as a contagion.

Among the wild animals ruminants are most often attacked, especially the roe, the stag, the reindeer, the buffalo,—and the elephant is not spared. Scientific investigations must decide in what relation certain pestilential diseases of other animals stand to anthrax—diseases which, affecting especially birds, mice, fishes, etc., in anthrax districts, are frequently regarded as cases of the latter.

Forel and du Plessis,[1] a few years since, described a malady resembling anthrax, among the small perch (*perca fluviatilis*) of Lake Geneva and its tributaries, in which bacteria were found in the blood. This infectious disease, though evidently of parasitic origin, and described as typhus, could not be communicated to other animals by inoculation.

As to its geographical area, anthrax is found in all latitudes and in all portions of the world, as Heusinger has proved by thorough research. In the farthest inhabited polar regions (Lapland, Siberia) it rages as in the temperate zones (Hungary) and in the tropics (West Indies). As to our special portion of the earth, anthrax, more or less severe, appears in nearly all the districts of Europe. It is most widely spread in Russia and Siberia, and is greatly dreaded in the latter as the Siberian boil-plague (Beulenseuche).

In 1864 there died in Russia, of the Siberian boil-plague, 72,000 horses (Hering's Jahresbericht für 1865, p. 32). In Gouvernement Nowgorod alone, during four years (1867–1870), according to Grimm (Virchow's Archiv, B. 54, p. 262), there perished of anthrax more than 56,000 horses, cows, and sheep, and 528 men besides.

Anthrax is particularly common in Hungary, in the districts of the lower Danube, and in certain parts of France (Auvergne, Beauce, Sologne, Eure and Loire). In Germany one of the chief anthrax districts is the Prussian province of Saxony.

Symptoms.

Since Chabert, the different forms of anthrax have been commonly separated into two great classes, the more nervous forms being designated carbuncular fever (Milzbrandfieber), the more anatomical, anthrax or carbuncle. While the former are particularly acute, and often last only a few hours, and depend seemingly more upon the action of the malarial and anthrax poisons upon the nervous system, the carbuncular and slower forms are more marked by anatomical and chemical changes.

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[1] Gaz. des Hôpitaux, No. 122, p. 487, 1868.

Among the carbuncular fevers, in which, from its short and usually fatal course, the disease does not reach the stage of local outbreaks, authors class the following: the apoplectiform, or lightning-like anthrax (*Erdsturz*, *Hexenschuss*, *Teufelsschuss*, *apoplexia carbunculosa*), maniacal anthrax (*Milzbrandwuth*, *rabies carbunculosa*), and finally, intermittent anthrax (*intermittens carbunculosa*). On the other hand, to the carbuncular and erysipelatous forms of anthrax, with local manifestations, belong the horse-typhus (*Pferdetyphus*), (Röll and Bruckmüller), tongue anthrax, rectal carbuncle, "Rückenblut," the carbuncular disease of cattle, anthrax carbuncle and sloughing erysipelas of sheep, and quinsy (mouth or gum anthrax), anthrax quinsy, the "Weisse Borste," and the sloughing erysipelas of swine.

The faultiness of this classification is due to the fact that even in the so-called carbuncular fever, in the most acute cases of the disease as I have proved, there never fail to be localizations of the malady; such are, namely, the jelly-like hemorrhagic infiltrations in the different internal organs, especially the connective tissue of the abdominal and thoracic cavities, and further, the intestinal carbuncle, which in its origin as well as anatomically, is indistinguishable from the external cutaneous carbuncle, as it is also from the local expressions of the disease in the neck, on the tongue, in the rectum, and in other places.

The different forms of anthrax, as affecting the domestic animals in a general way, may be more accurately arranged as follows:

1. *Apoplectiform anthrax* (*anthrax acutissimus sive foudroyante*), which only lasts from a few minutes to several hours.

2. *Acute anthrax* (*anthrax acutus*), lasting from a few hours to a few days.

3. *Subacute forms of anthrax* (*anthrax subacutus*).

Here should be included all cases of anthrax of a longer duration, especially the so-called horse-typhus.

Among the apoplectic and acute forms are to be reckoned apoplectic, maniacal, and intermittent anthrax—the carbuncular fever—while the majority of the erysipelatous and carbuncular cases would belong to the subacute forms.

The period of incubation of anthrax among the domestic animals has been variously estimated by authors. In many cases the disease is said to break out immediately after the reception of the infectious material. In medium-sized animals (sheep, goats), after inoculation, a period of incubation of three or four days has been observed, during which the animals have appeared entirely well.[1] The same holds good, apparently, for cattle and horses. For the former, according to my experience, the incubation hardly lasts longer than four or five days. Among the smaller animals (rabbits, cats) the incubation is twenty-four, thirty-six, or forty-eight hours—seldom three or four days.

On account of the numerous forms assumed by anthrax, the symptoms, during life, are much varied and difficult to depict.

In the apoplectiform cases, which are very frequent, and chiefly affect cattle and sheep, the animals drop as if they had received a blow, go into convulsions, show a rise in the pulse, and increased quickness in respiration, cyanosis, dyspnœa, and often in a few minutes the fatal termination is reached. In such cases it appears that the animals, immediately beforehand, showed a good desire for food, or were turned out to work in the full possession of all their functions. They are frequently found dead in their stalls in the morning, though having had the best appetite the evening before, and not having manifested the least morbid symptom.

Acute attacks of anthrax run the following course in cattle and horses. The animals, while in full health, suddenly suffer from a diminished appetite, or they lose it altogether. In milch cows there is a diminution or an entire stoppage of the secretion of milk. Thirst is increased; the animals begin to shake, and frequently there is a pronounced chill; the surface is cold. After a variable duration this coldness is succeeded by a marked heated stage. It is almost the rule to observe peculiar convulsive movements and clonic spasms of the extremities.

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[1] *Gerlach* (l. c.) estimates the duration of incubation in sheep at from thirty to forty-eight hours, reaching sometimes several—as many as six—days.

During the remissions the animals appear weak and depressed, or they may again seem in perfect health, eating and chewing the cud. The activity of the heart is increased; the number of pulsations nearly doubles the normal frequence; the temperature rises to 106° or 107° Fahr. The excrement is frequently either mingled with dark blood, or decidedly bloody and diarrhœal.

The symptoms above detailed generally appear in a paroxysmal manner. Between the paroxysms irregular remissions and intermissions may be observed, lasting a few hours—often six, twelve, or twenty-four.

In cases of the intermittent character the animals seem in the intervals to be entirely well, or have such inconsiderable symptoms of disease that the latter readily escape notice.

In fatal cases—and the mortality reaches about 70 per cent. among cattle and horses—the breathing during a paroxysm becomes labored and gasping (dyspnœa), such mucous membranes as are visible grow cyanotic, the extremities cool, the convulsions become violent, opisthotonos and convulsive contractions of the muscles of the eye are observed, so that only the white of the eye remains visible, the animal grows very weak, can no longer keep itself upon the feet, the temperature falls below the normal standard, the extremities become cold, the pupil is dilated to its utmost, and death follows in the form of asphyxia, generally twenty-four, thirty-six, or forty hours after the appearance of the first symptoms of the malady. On the other hand in cases running a favorable course convalescence sets in just as rapidly, and there is never any fear of sequelæ.

Although in a majority of the cases among cattle, cutaneous carbuncles are absent, the latter are more frequent in horses, and especially in the slower, less acute cases, extensive carbuncular infiltrations are frequently found, which generally occupy certain parts (by preference the head, neck, extremities, and the under portions of the breast and belly), and often present themselves as conical swellings of a board-like hardness.

In other respects the symptoms of the acute forms of anthrax are similar in horses and cattle. The animals suddenly show great weakness, they seem stunned, and there are hemorrhages into the mucous membranes within sight, especially the nose.

Difficulty of breathing comes on with increase in the pulse, elevated temperature, colic, together with convulsions, and a fatal termination may be reached in a few hours, though frequently not before several days have passed. As in the anthrax of cattle, so in horses these symptoms may show distinct paroxysms, remissions, and (although less pronounced) intermissions.

When cutaneous carbuncles occur, and in many regions they are seen even on cattle, cool and painless furunculoid swellings appear and quickly develop on different portions of the body. Pressure upon these spots shows them to be emphysematous, emitting a crackling sound (*Geräusch*, *rauschender Brand*). Should the disease not prove promptly fatal, large portions of integument are thrown off in slough, and enormous ulcers are often left behind.

In medium-sized and small animals (goats and rabbits) the symptoms during life are far less clearly marked; the dyspnœa, however, the dilatation of the pupils, and indeed the convulsions, may be observed.

PATHOLOGICAL ANATOMY.

As to the changes found on post-mortem examination, there is no essential difference between cattle and horses.

After death from apoplectiform or acute anthrax in cattle, the blood is found to be dark, thick, tarry, and unclotted, just as it is after blood-letting during life. The entire venous system is engorged. The spleen is regularly enlarged up to two, four, or five times its natural size. It is pulpy and softened in its parenchyma, and of a dark color. In the intestine it is customary to find a tar-like bloody substance; the intestinal walls (especially the small intestine) are more or less infiltrated with a sero-hemorrhagic exudation; similar jelly-like infiltrations are found in the omentum, the mesentery, in the mesenteric glands, and in the fatty tissue around the kidneys. The abdominal cavity often contains a sero-hemorrhagic effusion (Hydrops ascites). Large and small collections of blood are found in the muscular structure of the heart, and effusions of blood under the endo- and epicardium, especially about the auricles. In female animals the ovaries and uterus are often the seat of hemorrhagic effusions. Actual intestinal carbuncles are seldom seen in cattle.

The anatomical changes of anthrax in the horse differ especially from those found in cattle, in that the jelly-like yellow and sero-hemorrhagic infiltrations are encountered nearly everywhere in the body where there is loose connective tissue, chiefly in the retro-pharyngeal and laryngeal tissues, along the course of the great blood-vessels of the neck, in the mediastinum, peritoneum, and about the kidneys. The corresponding lymphatic glands, especially the mesenteric, show sero-hemorrhagic infiltrations, are considerably enlarged, and here and there in a state of commencing gangrene.

The intestinal lesions in the horse are for the most part not so diffusely spread ; but still upon the mucous membrane, which is in a catarrhal state, œdematous, and sprinkled with ecchymoses, there are found well-pronounced carbuncles, which are the seat of more or less superficial sloughing. The intestinal contents are likewise often bloody and thinly fluid.

The large glands, liver, and kidneys, as a rule, are swollen, the parenchyma cloudy, succulent, full of blood (trübe Schwellung).

In the blood, besides the presence of bacteria, the white corpuscles are found to be considerably increased in number. The red corpuscles, for the most part, are of lessened consistence, and manifest a tendency to cohere together in little heaps.

On microscopic examination of the carbuncles—in the intestine as well as elsewhere—and of the jelly-like hemorrhagic effusions into the connective tissue, there are found in the capillaries, which are considerably dilated, besides a massing of white blood corpuscles (cellular œdema), numerous bacteria, and a finely granular mass, consisting partly of metamorphosed blood detritus, and partly of bacterial germs.

In anthrax of smaller animals (goats, rabbits) the cadaveric changes are much less positively pronounced. The spleen is only slightly enlarged, there is not much of the jelly-like bloody effusion, the hemorrhages are more scattered, and œdematous and dropsical changes are often found. The blood in goats is thinly fluid, and in other respects shows the same variations from the normal type as in larger animals.

I could not remark any special tendency toward rapid decomposition in the cadavers of cattle and goats, which had perished of anthrax, although it was somewhat evident in horses. On the other hand, rigor mortis was almost constantly absent. The latter is explicable, as is the softening and the cohesiveness of the blood corpuscles, and the failure of the blood to clot, by the special property, which the bacteria possess, of rapidly softening albuminous bodies.

The increase of white blood corpuscles is evidently a direct result of the acute irritation and swelling of the lymphatic glands and of the spleen, giving rise to a lively production of lymph cells. It is easy to understand that the bacteria and bacterial germs, which are found in great numbers in these organs, occasion an abnormal irritation there, as indeed was proved, even in man, by Buhl.

The thickness of the blood is due to its being deprived of water by the dropsical, jelly-like, and œdematous effusions. The dark color is caused by carbonic-acid poisoning.

The carbuncles, the œdematous infiltrations, the transudations, the hemorrhages, are explicable partly by the already detailed mechanical obstruction (embolism), partly by the chemical action of the bacteria, an assumption which (as has been thoroughly discussed by me in another place, l. c.) appears to be established by various experiments, especially those of L. Franck.[1] The local hyperæmias, the cellular œdema, in part the hemorrhages, are due on the one hand to the blood changes, but, on the other, the acutely disturbed nourishment of the walls of the vessels is to be borne in mind as a factor of not less importance.

A few words on the diagnosis, prognosis, and treatment are all that is required to conclude what we have to say concerning anthrax of the domestic animals.

Prognosis.

The prognosis of anthrax is very unfavorable. As already stated, the percentage of mortality in cattle and horses reaches about seventy. In the most acute cases, the apoplectic form, recovery is the greatest rarity, and in less acute attacks the mortality is placed by many authors as high as from 75 to 80 per cent.

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[1] Jahresbericht der Centralthierarzneischule zu München, pro 1869–70, p. 22.

Diagnosis.

Outside of anthrax districts, the diagnosis during life, especially of sporadic cases, is often made with difficulty, and frequently is absolutely impossible. An examination of the blood of the living animal—which I was frequently induced to undertake to verify the diagnosis—gives, as a rule, a negative result, when the blood is taken from the animal during an intermission, or a remission, and in such cases inoculations are also unsuccessful. The same holds good for cases which have gone into convalescence. An autopsy, as a rule, leads to a positive conclusion, and in doubtful cases, inoculation of rabbits, guinea-pigs, goats, and sheep is a sure and befitting adjuvant to diagnosis.

When in the blood of a living animal, or immediately after death, the characteristic bacteria are encountered, the diagnosis is assured beyond a doubt; but, on the other hand, should the latter not be found, it cannot be decided that anthrax is not present, as is evident from the views which have been already advanced concerning the behavior of these organisms.

The difficulty of a certain diagnosis of anthrax lies chiefly in a lack of unanimity as to just what is to be considered anthrax—a feature which added not a little to the confusion which long existed in the anthrax question, as it did also in the bacterial question. Haubner appears to take the proper position when he declares that anthrax itself is seldom mistaken, but that other maladies are often incorrectly considered to be anthrax. To this class of diseases belong, according to my experience, putrid infection, septicæmia, and other specific maladies,—as for example, the so-called erysipelas of swine (Rothlauf),—which in a measure. and indeed in different particulars, bear a strong resemblance to anthrax, but in reality are very different.

Prophylaxis.

Contrary to the prevalent opinion that the prophylaxis of anthrax in districts where it is enzootic is difficult to carry out effectively, I have no doubt, as may appear from what has already been said, that the effort is well worthy of trial. If it is established that only such soil as has been impregnated with the anthrax poison constitutes a source of disease, and since we know that the malady apparently has its exclusive existence through infection, by transmission of the poison,—let this occur as it may, through the wind, the water, food, insects, or in any manner,—and since we know that the poison is in the highest degree transportable—means and ways immediately suggest themselves by which a successful contest may be maintained against this fearful enemy. Careful disinfection, thorough disposal of the dead, of the excrement, and of all objects to which portions of the diseased animals may adhere, protection from insects, etc., are, as numerous and well-attested facts teach us, the most important elements in the struggle with this disease.

In addition to the above, as a matter of course, such general regulations as have a bearing upon the improvement of the conditions of the soil, and the establishment of more perfect drainage, are of the greatest significance. The prophylactic employment of antiseptic means (as carbolic acid) in the drinking-water has here and there been proved of service.

The legal enactments relating to these subjects in most states are, in the main, ample to cover the ground, and when they are thoroughly carried out, offer a certain guarantee against the transmission and extension of the malady. Yet, according to my experience, collected on the spot, in connection with many cases of anthrax, the sanitary police regulations are generally carried out in an entirely unsatisfactory manner. In enzootic anthrax, at least, the frequency of the disease certainly bears relation to the manner in which the above-mentioned preservative measures are carried out (disinfection, disposal of cadavers, and of all things pertaining to the diseased animals). It is therefore entirely incomprehensible to me—again supported by special experience—how so well-versed an observer as Haubner (Handbuch der Veterinärpolizei, Dresden, 1869, p. 291) can desire to limit the sanitary police regulations down to instruction, and to leave the rest to self-protection; and this, too, on the ground that while anthrax is indeed an enzootic and infectious disease, it is not contagious. Such a plan ignores the transportability of anthrax poison, and its tenacity in the soil (or its adhesiveness to all sorts of objects), and even allows the skin of the cadaver to be removed—without other precautions than simple disinfection—and to be put to further uses. The experience in Hesse and in Saxony, above adduced, corresponds exactly to the conclusions which I arrived at from my experience in this direction in many parts of Switzerland, all going directly to show the necessity of exercising the strictest police control.

Treatment.

Among the remedies which have been used for anthrax, blood-letting is the one most commonly resorted to, with—in the beginning of the disease—laxatives. The following measures have also been recommended: the internal use of acids, cold showering, irritation of the skin, and, in weak conditions, excitants.

Aside from all these remedies, the therapeutical value of which is thus far, to say the least, doubtful, advantage has frequently been derived of late from carbolic acid as a prophylactic as well as after the disease has declared itself, and I can personally certify to its value when appropriately employed.

ANTHRAX IN MAN.

(Malignant pustule. Carbunculus contagiosus.)

Anthrax in man has been hitherto almost entirely yielded to the domain of surgery, and too little attention has been bestowed upon it by the representatives of internal medicine. So much so, indeed, that one of the most recent, thorough, and popular text-books of special pathology and therapeutics simply refers to text-books on surgery for information on this subject, on account of its "especial surgical interest."

Aside from the fact that anthrax, as a typical infectious disease, might claim, on the ground of utility alone, a prominent place in the teaching of the internal diseases, certain truths which have come to light of late years prove most plainly that this pest has nearly the same claim upon the physician as upon the surgeon.

The appearance of anthrax in man has been long known. We are, however, especially indebted to French physicians and veterinarians of the last century (Fournier, 1769; Montfils, 1776; Thomassin, 1780; Chabert, 1780) for positive descriptions and for the distinctive characteristics of the different forms. Fournier first distinguishes the spontaneous and the communicated carbuncle of man. The existence of the latter he ascribes to the eating of the flesh and the handling of wool of diseased animals in manufactories. While Kausch (1790–1811) denied the contagiousness of anthrax, he granted the frequent infection of men, and intimated that the malignant pustule (schwarze Blatter) of man derived its exclusive source from inoculation of the anthrax of animals.

The primary existence of anthrax in man was again stoutly defended, and supported by allusion to numerous facts, by Bayle (1800) and by Davy la Chevrie (1807).

When compared with the development of medicine in general, the progress toward a knowledge of anthrax in man was not very considerable during the first half of the present century, as the admirable work of Heusinger (1850) very clearly reveals. We have already referred above to the historical and geographical investigations of Heusinger, and have only now to state that, subsequently, many authors, especially Virchow, Bourgeois, Davaine, Guipon, Korányi, Nicolai, and others have done good service in relation to our knowledge of anthrax in man, while a list of new observers (Buhl, Waldeyer, E. Wagner, Münch, W. Müller, Leube, and others have called attention to forms of anthrax in man, which, although of great importance, had been hitherto but little noticed.

Etiology.

As in the case of other infectious diseases, we must decidedly deny the spontaneous origin of anthrax in man. Since we have endeavored to prove above that, even among the domestic animals, anthrax never appears spontaneously, and that the infectious material — anthrax bacteria — reproduces itself endogenously in the bodies of the diseased animals, the much disputed question of the spontaneous origin of anthrax in man, it would seem, may be denied on the same grounds. If, on the other hand, we put the question thus: Can man, without direct inoculation of the anthrax poison, emanating from a diseased animal, suffer primarily from anthrax? our answer would be, that, thus far, we are possessed of no facts which in any way prove this method of genesis for anthrax in man, or even make it probable. By the earlier investigators (Bourgeois, Guipon, and others) the spontaneous origin of anthrax was denied, in opposition to Bayle, Davy, and others, yet the same was newly affirmed with all positiveness by experienced observers (for example, Nicolai), who for a long time practised continuously in anthrax districts. But even Heusinger (l. c., p. 561–571), who has collected the previous sentiments of authors on this subject, cannot conceal the objections which militate against spontaneous development; and, likewise, Virchow (l. c., p. 402) doubts this method of genesis of anthrax, while Korányi (l. c., p. 199) considers the solution of the question as yet impossible. I have already stated in another place (l. c., p. 117) that even the cases of intestinal sporadic anthrax (Buhl, Waldeyer, E. Wagner), which have been published during recent years, could hardly furnish any support for the spontaneous origin of the disease in man. I explained these cases by supposing the infectious material to have entered the organism through the intestinal canal, and especially emphasized the fact, that after establishing the tenacity of the contagious material of anthrax, and the manifold means by which it may be acquired, all remaining cases (those apparently spontaneous) are to be ascribed to indirect inoculation. The more recent publications of Nicolai, E. Wagner, Leube, and Müller fully ratify this view. Since those authors who collect their experience from anthrax districts are unable to give us any information of the so-called spontaneous origin of anthrax, we are justified in giving it up unconditionally; but yet we willingly concede that the mediate communication of the poison—which is diffusable and transportable as is hardly any other—might very easily give rise to a belief in a spontaneous origin of the disease.

This transportability of anthrax poison for long distances was also distinctly recognized by Guipon (l. c.). Facts in our possession show beyond a doubt that it is imported into Europe from Siberia, and over the Atlantic Ocean from South America as well, and that too not unfrequently. More than a hundred years ago (1769) Fournier reported upon the frequent and very common method of transmission of anthrax to men, in the manufacture of the wool of diseased animals, in the tapestry works of Montpellier. The great tenacity of the poison was also known to Fournier, as well as the fact that it retained its virulence through many years. Likewise Montfils (1776) relates that anthrax is transmitted to man in part by handling diseased animals, partly by the manufacture of their hides, hair, wool, etc., as well as by the bites of flies.

As a residence in an anthrax district does not necessarily produce the disease in man, neither is the neighborhood of diseased animals a sufficient cause for its occurrence. If we investigate more closely the different ways in which man acquires anthrax, we shall find that the following modes may be established :—

1. *The Direct Inoculation of the Poison.*—This applies especially to individuals who in the course of their occupation come into contact with diseased animals or their remains, as for instance, shepherds, husbandmen, laborers, tanners, butchers, veterinarians, and workers in hides, in horsehair, in woollen fabrics, and in paper-making. Such manipulations as are required in blood-letting, slaughtering and skinning animals, and in burying them or preparing them for food, manifestly expose to the greatest danger. In such cases the inoculation is generally external, and the point of entrance of the poison is situated ordinarily on those parts of the body which are the seat of slight injuries or are deprived of epidermis.

One of the most common methods of infection is in the washing of wool, hair, etc., derived from diseased animals. Besides what has been said by Fournier (already given) and the cases of Trousseau, cited by Virchow, some more recent observations are worthy of notice. Kolb[1] reports several cases of inoculation of anthrax by means of rags which were used in a paper factory in Styria. Among the thirty or thirty-five hands of a paper factory, Dokahl, during the course of four or five years, treated eleven cases of malignant pustule due to the above cause and terminating fatally in from forty to forty-two hours. Borstieber[2] narrates that, in Waag-Neustadt and the neighborhood, where the chief business is in wool, tanning, and the manufacture of coarse hats from wool, anthrax is very frequent in man, and often terminates fatally. Malignant pustule may arise from simply carrying the hides and skins of diseased animals. Broca[3] noticed that the workers in leather establishments often got anthrax carbuncle on the side of the neck. He explains this from the manner in which the laborers carry the hides, and advises the use of protective bands about the neck.

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[1] Deutsche Vierteljahrschrift für öff. Gesundheitspflege, II., p. 316, 1870.

[2] Wiener, med. Presse, Nos. 7 and 8, 1870.

[3] Bull. de l'Acad. de Méd., XXXIII., p. 367, 1868.

Moreover, it has been established by numerous observations, that anthrax poison adhering to the uninjured skin is able to penetrate into the body through the cuticle—probably by first entering the hair follicle.

2. *Eating the flesh of diseased animals*, as also their milk, or the butter made from it. In this form of infection the poison may enter the body either through some slight epithelial abrasion on the lip or in the mouth, or directly through the stomach; or, finally, the bacteria may penetrate into the lungs during the eating of infected food.

This method of acquiring the disease is relatively infrequent. In the great majority of instances infected flesh is eaten by man without injury; indeed, such meat, after being properly roasted or boiled, is generally harmless. Man in this respect resembles the carnivorous animals (dogs), whose gastric juice, as has been experimentally proved, is capable of destroying the poison even in raw flesh. From various facts, however, bearing upon this point (Schwab, Wasservogel, and others), the assumption that by cooking the meat the poison will always be destroyed, must be set down as incorrect. I myself have never witnessed the least disagreeable result in men who had eaten the flesh of animals that had perished by the most acute and formidable forms of anthrax. In many cases it is difficult to decide whether the eating of the flesh or direct contact with it is the cause of the infection, since the latter almost always co-exists with the former.

A few proofs may be adduced in support of this latter supposition. Meyer[1] observed that not one out of two hundred men who had eaten the flesh of a diseased ox became sick, while five persons who had handled the flesh were attacked with anthrax, and three of them died. Wasservogel[2] reports a case where in one family three children, who had only eaten the flesh of a diseased animal, but had not assisted in preparing it, remained well, while nearly all the other members of the same family, who had prepared the same animal for eating, got malignant pustule, and one of them died. That the milk and butter of sick animals likewise possess virulent properties is proved, according to Heusinger (l. c., pp. 29, 30, and 39), by numerous observations in America and Russia. The malady so produced is the "*milk sickness*" of the Americans. As to the noxiousness of milk, as established by experiment, see my results already given.

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[1] Preuss. med. Vereinszeitung, 1841, p. 149.

[2] Allg. Wien. med. Zeitung, 1871, Nos. 1 and 2.

3. *The transmission of anthrax from the domestic animals to man is often effected by insects* (flies) which have been in contact with diseased animals. Certain more recent observers (Davaine and Raimbert) have sought to establish this mode of infection (which has long been known) as the exclusive source of the spread of anthrax; but they are not justified in this, as we have shown above. Evidently the proboscis of the fly (especially the blue-bottle fly) plays a prominent part in the propagation of the disease.

Since the anthrax pustule, as we shall see later on, first calls attention to its existence by a pricking pain like that of the bite of a fly, the patient is apt to draw a faulty conclusion from this subjective fact, and to state that he has been bitten by a fly, while in reality the inoculation has been due to direct contact, as several reported observations (my own, among them) show. To this category apparently belongs the case narrated by Siederer, where the bite of a flea is said to have been the point of entrance of the poison in a man who carried flesh of diseased animals on his shoulders.

4. A further form of anthrax infection (although a very infrequent one) is *the inoculation from man to man.* This method of propagation was observed by Thomassin, Kessel (two women infected by their husbands), Helbich, Nicolai, and Hausbrand (see Heusinger's statements, l. c., pp. 25, 34, 41, and 45).

Since the virulence of anthrax in man has been established by re-inoculation upon different animals—dogs (Hoffmann), rabbits (Greese and Gayet), guinea-pigs (Davaine)—there is no possibility of doubt on the subject,[1] and infection from man to man cannot be denied. The immediate transmission of the poison in this manner, however, must be less frequent than the same between animals and men. Mediate infection, on the other hand, may certainly occur very often, as is shown in a case recently reported by Leube.

5. As a final mode of transmission of anthrax to man, *internal infection* is still to be mentioned, where the poison—anthrax bacteria—enters the body either in the inspired air or with the nourishment. Here belong those cases which we have recently learned to consider as intestinal anthrax (*mycosis intestinalis*), where infection has taken place by eating diseased meat; and further, such cases of anthrax as follow upon a sickness which

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[1] *Guipon* and others.

was at first general—a blood poisoning with symptomatic carbuncle.

It may be assumed with all plausibility, following the analogy of cutaneous carbuncle due to external infection, that in intestinal anthrax the digestive organs furnish the point of entrance of the poison. The bacteria are probably taken in with the food, and a portion of the fungus not destroyed by the gastric juice settles upon different parts of the intestine and there produces its effects.

We have now to mention *the points of predilection* where in external anthrax the poison finds its entrance. Anthrax pustules chiefly occupy uncovered portions of the body (84 per cent. Virchow), namely, the face, forearms, hands, fingers, neck, less often the ear; while on covered parts of the body (arms, feet, lower extremities) carbuncles do not occur in more than 16 per cent. of the cases; in women and children, however, many of whom habitually have those parts more or less uncovered, they are not a very uncommon seat of the pustules.

In general the cutaneous carbuncles have their seat on parts where direct inoculation of the poison is easily possible—by flies, by contact with infected objects, etc. A sort of auto-inoculation is possible where any part of the body is scratched with fingers soiled with anthrax blood.

As to anthrax bacteria, their nature and special peculiarities, we must refer to what has been already said of them in connection with anthrax of the domestic animals, and may sum up our views of the etiology of anthrax in man as follows:

Anthrax in man is most frequently found where the disease rages as an enzootic among the domestic animals, and it is peculiarly apt to attack those who have to do with diseased animals, living as well as dead, and those who work in industrial establishments where the products of diseased animals are manufactured (especially hides, horsehair, and wool). Anthrax in man is, therefore, truly a disease attaching to certain occupations. In many cases, however, it is absolutely impossible to establish the source of the infection.

Finally, as to predisposition to anthrax, man is not so susceptible to the disease as are the animals. In my own experience, when considering the manifold dangers of infection to which man is exposed, I cannot believe that he has more than a moderate predisposition to the disease, and doubt the value of contrary assertions (for example, by Korányi) which set him down as eminently predisposed to it. In this respect man is certainly more like the carnivorous and omnivorous animals (which take the disease with difficulty) than the herbivorous.

The cause of certain individual peculiarities of predisposition is difficult to explain. That men (59 per cent.) should suffer from anthrax more frequently than women (41 per cent.)[1]—proportions, however, which hold only for anthrax districts—is easy to understand from what has already been said. In anthrax districts children participate in the number of the sick only to the extent of 16 per cent. The majority of the patients are between ten and fifty years of age.

A single attack of the disease does not overcome the predisposition to acquire it, as the malady may seize upon the same individual again.

As to the effect of season as an accessory cause of anthrax in man, the same rule holds good as in the case of the domestic animals; that is, the summer months, July, August, September, furnish the greatest contingent of cases in anthrax districts.

Symptoms and Course.

In man the first symptoms of anthrax, which occur after infection, are varied, and depend seemingly upon whether the poison has entered through the integument or through the internal organs (digestive canal or breathing apparatus).

While the cases of external infection are much the more common, and, as a matter of course, come more frequently under the notice of the surgeon, and only in the later stages furnish the fearful symptoms of blood-poisoning, still attention has been directed by a number of recent observations toward the far more dangerous internal infections. At present we will first consider anthrax as it affects the skin (external infection). It appears under two especial forms: the primary *anthrax carbuncle*, and the much less common *anthrax œdema*.

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[1] In making up this estimate children are not included.

After an incubation of variable duration, lasting occasionally only a few hours, generally several (rarely longer than from twelve to fourteen) days, the patient notices on the part which has come in contact with the infected matter, a slight burning and itching, like that which is felt after the bite of an insect.[1] Inspection of the region implicated reveals a little red speck, like the bite of a flea, with a central black point. By gradually swelling, the spot very quickly becomes changed into an itching papule, capped with a small, clear, generally reddish or bluish vesicle, which gradually enlarges. This promptly bursts, and discloses a dark red base. The actual anthrax pimple, which naturally runs this course, is generally scratched off before it has reached the size of a pea. The excoriated spot dries up, becomes brown and livid, and a local eschar forms. By inflammatory swelling of the surrounding skin a red or violet raised border is formed, and around this very frequently a bluish or pale yellow ring, upon which little vesicles, of the size of a hemp-seed, often appear, and surround the central eschar like a wreath. These secondary vesicles contain a yellowish, reddish, and blackish fluid, but sometimes they are absent, as well as the red raised border. With an increase of the round, thick eschar, which measures from a quarter to three-quarters of an inch in diameter, the raised border also extends. The dense (or doughy) soft papule or pustule, situated around and beneath the eschar, varies from the size of a pea to that a nut.

The tissue in the immediate neighborhood becomes indurated very quickly, and this œdematous swelling rapidly spreads over a considerable area—the entire arm—half the neck—occasioning lively pain and a feeling of heaviness in the affected extremities. The general condition may still be normal; the patients often continue at their business, or they complain especially of an uncomfortable feeling in the head, have slight chills and evidences of mild fever.

In cases which run an unfavorable course, or where no treatment is resorted to, the œdema and infiltration of the cellular tissue spread rapidly ; the skin of the affected parts is either hard or doughy, or, in rare cases, also œdematous, more or less reddened, sometimes cool, sometimes hot. In many cases discolored lines appear over the veins of the œdematous region, or red lines and stripes mark out the course of the lymphatics ;—the corresponding lymphatic glands also swell.

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[1] According to the careful description of Wasservogel. Wien. med. Zeitung, No. 2, 1872.

The general symptoms in the further course of the disease are but little constant. The febrile movement, slight in the beginning, is often followed apace by high fever, great weakness, delirium, excitement, confusion; it is also frequently attended by sweating, diarrhœa, and severe pains in the extremities and joints. In bad cases, a sudden fatal issue, preceded by extreme collapse, is not uncommon. But in this connection it is always proper to remember that a secondary septicæmia may complicate anthrax, especially when grangrene and sloughing attend the local cutaneous lesion. E. Wagner thus explains the difference which in many cases is observed between the phenomena of constitutional carbuncular poisoning and the same as witnessed in intestinal anthrax. In the more serious cases there may be observed a considerable increase in the frequency of the pulse, cold sweats, a feeling of anxiety, difficulty of respiration—more rarely clonic spasms, trismus, opisthotonos.

In cases which terminate favorably, as they often do after energetic local treatment, even when the symptoms have reached a very formidable height, the general symptoms disappear along with the local infiltration.

Therefore, in a general way, we may assume, with Bourgeois, that there are two periods in the development of malignant pustule, of which the first is characterized exclusively by local symptoms, and lasts from forty-eight to sixty hours, while the second period begins with the commencement of the general symptoms. The duration of the latter in fatal cases is at most from five to eight days. In favorable cases the eschar is thrown off either by suppuration, or after the formation of a line of demarcation, without appreciable suppuration.

It is to be observed as a very important fact, that, after infection has taken place, anthrax retains its local character much longer in man than it does in animals.

According to the investigations of Renault,[1] cauterization in animals is without result, even when it is made ten or twelve minutes after the inoculation. Guipon states (l. c.) that the disease lasts, in about half the cases, from one to ten days. The other half is divided in such a way that one-sixth lasts from eleven to twenty, one sixth from twenty-one to thirty, and the remainder over thirty-one days. Cases which last more than three or four months are exceedingly rare. Just as rare are those very acute cases after external infection, which end fatally in two or three days after the outbreak of the pustule.

The second variety of external carbuncle is the *malignant anthrax œdema* (*l'œdème malin*, Bourgeois), first noticed by that observer simply in the eyelids, but later in other parts of the body as well. This only differs at the start from the common carbuncle—malignant pustule—in that the vesicle and the primary eschar are wanting. There may be observed a somewhat pale, yellowish or greenish swelling, which, in the eyelids, has often a half-translucent aspect.

This form, which Virchow has described as the diffuse or erysipelatous anthrax carbuncle, approaches very nearly to the anthrax eruptions of the skin and subcutaneous cellular tissue, which are frequently observed among the domestic animals, especially horses, and are commonly described as carbunculous swellings, or simply as cutaneous carbuncles. Guipon believes that this anthrax œdema occurs chiefly as a consequence of inhaling infected air, and he therefore classes it etiologically with symptomatic and secondary cutaneous carbuncles. Scientific researches must establish the soundness of this view before it can be adopted. In some cases erysipeloid anthrax œdema has been observed after eating the flesh of infected animals,—without the appearance of any carbuncle.

Here, perhaps, belong also those cases of carbuncle which appear in different situations several weeks after the manipulation of infected material.

Although in the local circumscribed carbuncle the course of the disease is often so mild that the patient is not interrupted in his ordinary avocation, yet, when general infection has occurred, the eruption is frequently multiple in different parts of the body.

On the other hand, in observing the picture of the disease as it occurs after internal infection—that is, after actual feeding upon diseased flesh—we find here the uniting link, constituting the point of contact with the cases of intestinal anthrax, such as they have been described of late years.

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[1] Union Médicale, 1857, p. 482.

The older observers had already noticed (Carganico)[1] that, after eating the flesh of infected animals, a general malady was often occasioned in man, which offered the greatest similarity to a poisoning, namely, to that caused by poisonous mushrooms.

The first symptoms after eating diseased flesh often come on very quickly—as early, indeed, as at the end of eight hours. The patient complains of feeling chilly, of debility, of headache; or the disease is ushered in[2] by a general feeling of malaise, loss of appetite, restless sleep, great debility and depression, after which—but often not until eight or ten days have elapsed—anthrax carbuncles first appear, by preference on the arm, forearm, and head. In fatal cases the accompanying œdema (with a superadded gangrenous process) spreads itself very rapidly over the whole extremity, collapse quickly comes on, with difficulty of breathing, loss of consciousness, and finally death. Frequently in from twenty-four to forty-eight hours after eating infected flesh there will be a decided chill, followed by pain in the belly, nausea, vomiting, and—after the malady has lasted two or three days, with the supervention of collapse and cyanosis—death, without there having been any local formation of carbuncle on the external surface of the body (Leube and Müller).

Heusinger has collected similar cases: Winkler (l. c., p. 41) describes a case where a woman, after eating some liver taken from a diseased animal, died in twelve hours, without the formation of any carbuncles. Lorinser (ib., p. 43) relates that two persons, after eating diseased flesh, were seized with vomiting, and that one of them died before any carbuncle had developed.

While we now pass on to describe the symptomatic features of *intestinal anthrax* in man, we must premise with the remark that, on the whole, our knowledge is still far from complete concerning this form of the disease, which is, perhaps, more common than has been hitherto supposed—and this we say in spite of certain recent and very valuable observations which lead to a different conclusion.

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[1] Rust's Magazine, XLIV., p. 387, 1835.

[2] *Menschel*, Preuss. med. Zeitung, 1862, No. 23, p. 180.

The earlier authors were well acquainted with the fact that after external infection anthrax may sometimes come to a local outbreak even in the internal organs, especially in the neck (anthrax quinsy).

On account of the relative rarity of anthrax in man—since in the largest hospitals it is frequently never observed during many years—it is easy to conceive that these uncommon forms were forgotten, and that it became the custom to connect the idea of anthrax in man almost exclusively with cutaneous carbuncles.

In this way it may be explained why intestinal anthrax of man, which of late has had to be rediscovered (first by pathological anatomists), was regarded by the first observers as an intestinal mycosis. According to our present knowledge of the essence of anthrax, it is not to be denied that the character of the malady was in the main correctly indicated by the term intestinal mycosis; and just this circumstance, which rendered possible a full, free, and unprejudiced analysis of the entire picture of the disease as a whole, did perhaps more toward furthering our knowledge of this interesting malady than would have been the case had the anthrax nature of the process been recognized from the first.

After von Wahl and von Recklinghausen (1861 and 1864) had already, at an earlier date, published similar observations, attention was again called recently to the different and important relations of these processes by Waldeyer, E. Wagner, Leube, and W. Müller. On account of the few records of its clinical course, it is entirely impossible at the present time to give an exhaustive picture of intestinal anthrax.

The symptoms often first appear as debility and depression, with pains in the limbs, a general sense of malaise, pain in the head, dizziness, ringing in the ears, followed very soon by disturbances in the intestinal canal. The patients complain of loss of appetite and gastralgia; there is moderate swelling of the belly, and in many cases a slight difficulty in swallowing. With an increase of the general symptoms vomiting commonly sets in, followed by a painless, moderate, or more or less intense, often bloody diarrhœa, whereby, in very acute cases, the patients very quickly fall into a cholera-like collapse. As a rule, also, there are present difficulty of breathing, cyanosis, great restlessness, excitement or somnolence, loss of consciousness; or the patients are fully conscious and only complain of great pain in the head, or a moderate, sometimes colicky pain in the belly. The breathing is difficult and accelerated, the pulse small and frequent, the temperature very slightly elevated,—in those cases where the thermometer was used. In several cases epileptiform convulsions were observed, tetanic spasms of the upper extremities, opisthotonos, and great dilatation of the pupils. In one case (E. Wagner) the course was irregularly intermittent. Localizations of the disease are frequently found on the integument, in the shape of little carbuncles, a diffuse phlegmon, or gangrene. On the mucous membranes of the cavities of the mouth and nose bloody suffusions and hemorrhagic collections are seen. There is continued bleeding from the mouth, and the escaped blood shows a lack of power of coagulating. In the cases thus far observed, with one exception (case of Leube), the termination was always fatal either within the first twenty-four hours, or after two, three, five, or seven days—with symptoms of cyanosis, asphyxia, and the most extreme collapse.

The entire picture of abdominal anthrax shows a certain concordance with the acute forms of anthrax in cattle (carbuncular fever) as we have above described it in detail.

As characteristics, then, in the majority of cases we find *the suddenness of the invasion, the rapid course and the stormy outbreak of the phenomena, among which are to be especially noted vomiting, diarrhœa, cyanosis, and rapidly following collapse.*

Localizations on the integument and visible mucous membranes may be present at the same time, as a matter of course, and from the data of a great number of autopsies of cases of intestinal anthrax, which Münch observed (in Moscow), the conclusion may be drawn that pure cases of abdominal anthrax, without carbuncle of the integument, constitute altogether, in many places, from one-third to two-fifths of the cases of anthrax in man.

The existence of internal anthrax carbuncles, in men who died of external carbuncles, had already been established by a number of older observers (Heusinger, p. 597). Virchow describes, as constituting a peculiar form of anthrax, those cases where general symptoms precede the outbreak of the secondary (external) carbuncles, and in these cases the latter appear not alone upon the skin, but also in all possible situations, even in the internal organs. The description which Virchow gives of the symptoms of this dangerous form of the disease, which generally runs an acute course, corresponds in the main to the picture of our intestinal anthrax. After the first observations of von Wahl and von Recklinghausen, followed the important case of Buhl (l. c.) (in which I made the autopsy), which was marked by numerous peculiar hemorrhagic and superficially escharred infiltrations of the stomach and intestine, as well as by the localized presence of the pathognomonic bacteria in the blood of the vena porta. Although Buhl (l. c., p. 138), while enumerating analogous processes in his remarks, explicitly mentions anthrax, he seems (in view of Davaine's conclusions concerning bacteria, which at that time were still hotly contested) not to have recognized the anthrax nature of his case, describing it as *mycosis intestinalis*. Waldeyer (l.c.) immediately thereafter reported two similar cases, which, however, aroused in him the suspicion of anthrax, especially as there were present in one case papular and pustular hemorrhagic foci of the integument. Münch (l. c.) observed, in a great number of autopsies of anthrax cases, changes which were similar in quality to those noticed in the cases of Buhl and Waldeyer.

After E. Wagner (1872) had accurately described another case of mycosis intestinalis, there followed, quite recently, the publication of a great number of observations by E. Wagner, Leube, and Müller, which positively decide the anthrax nature of these mycosis cases, and thus ratify (in every way, experimentally as well) the opinion which I decidedly pronounced regarding the identity of the same with anthrax—an opinion which I arrived as in my anthrax investigations in 1872.

PATHOLOGICAL ANATOMY.

Although there have existed until very recently only a small number of data of the pathological lesions of anthrax in man, the observations of the last few years have furnished us with a number of positive accounts of autopsies which now make it possible to undertake a general description.

The bodies show—contrary to a very common impression—a more or less marked rigor mortis, and, moreover, a pronounced cyanosis.

In the dermoidal forms of anthrax, due to external infection, bloody spots are often noticed in the skin. In the parts involved are found the characteristic papules and pustules, generally accompanied by extensive œdematous and phlegmonous infiltrations of the neighboring skin and subcutaneous tissues. It is customary to find, also, small and large epidermal vesicles filled with serum, and large cutaneous eschars.

In cutting into the anthrax pustule the process is seen to penetrate quite deeply into the subcutaneous cellular tissue. From the tough infiltration, which is hemorrhagic, and often sloughed in the centre, blackish-red hemorrhagic bands go off into the underlying adipose tissue, and send into it numerous branches. The external superficies of the carbuncle appears of a dirty blackish-red, greasy, and often more eroded than ulcerated. The œdematous and phlegmonous swellings show the changes of cloudy œdema, being often striped and flecked with blood.

The blood in the heart and great vessels is of a dark cherry-red, generally fluid, or with some loose clots.

Most of the *mucous membranes* are injected and reddened, the submucous tissue, especially in the fauces and around the larynx, being thickened and œdematous. The tongue is often covered with a thick, brown coat. At different points on the mucous membrane of the mouth it is usual to find dark, red, bloody ecchymoses and (more seldom) superficially escharred pustules.

The lymphatic glands in the neck,—the submaxillary, laryngeal, and retro-pharyngeal—when the above-mentioned changes in the mouth and pharynx occur, are infiltrated, hyperæmic, filled with hemorrhagic foci, colored of a grayish or of a dark blackish-red, and considerably enlarged. The surrounding cellular tissue is infiltrated with a cloudy serum and small hemorrhages.

The lungs are, on the whole, but little changed. Subpleural ecchymoses are found with vascular engorgement and a dark coloring of the parenchyma. There is often a slight serous effusion into the pleural cavities, together with œdema of the mediastinal connective tissue, and swelling of the mediastinal lymphatic glands.

The heart, as a rule, is not materially altered.

In the abdominal cavity, in intestinal anthrax, there is generally a moderate serous or sero-hemorrhagic effusion, and subperitoneal suggillations in moderate amount; the retro-peritoneal and mesenteric connective tissue is infiltrated, jelly-like, and of a yellowish and reddish color.

The walls of the stomach and intestine appear on section more or less œdematous, and colored of a cloudy red. Besides the changes of an acute catarrh, there is encountered in the digestive tract—especially in the small intestine—a thinly fluid material, often slightly colored with blood. On the reddish and swollen mucous membrane of the stomach and intestine are found isolated or numerous œdematous, hemorrhagic, prominent infiltrations,—most of them varying from the size of a lentil to that of a coffee bean—which show a grayish or greenish-yellow discolored surface, with a positively sloughing centre. Besides these genuine stomach and intestinal carbuncles—which are also encountered in the rectum, and appear, upon section, to consist of the tissue of the mucous membrane, infiltrated in a hemorrhagic manner—there are seen, also, simple hemorrhagic infarctions and foci in the different parts of the intestine.

The mesenteric and retro-peritoneal glands are enlarged, as a rule (like the glands of the neck, which have been already described), to the size of a walnut. They form dark, blackish-red masses, held together by a jelly-like connective tissue, infiltrated with serum.

The spleen is ordinarily only moderately enlarged, of soft consistence, full of blood, and of dark color. *The liver*, also, is engorged, and shows slight hemorrhages here and there.

The kidneys—whose capsule of connective tissue and fat is often swollen with œdema, and sprinkled with small hemorrhages—are also engorged, and frequently show suggillations in the mucous membranes of the pelves. In other respects the urinary and genital organs are very little altered.

The membranes of the brain often exhibit circumscribed or symmetrically extended bloody infiltrations. Here and there, in all parts of the brain, are to be found small and large hemorrhages, which for the most part (E. Wagner) are of embolic origin.

In glancing again over the above-depicted changes we notice, beside the carbuncles and œdema of the skin, as the most important: *peculiar pustular and carbuncular foci in the intestinal tract, transudations into the serous cavities, serous and sero-hemorrhagic infiltrations of the peritoneal and mesenteric connective tissue, of the walls of the stomach and intestine, and of the mucous membranes as well; hemorrhagic infiltrations of the mesenteric and other lymphatic glands; hemorrhages in different parts of the body; and frequently an enlargement of the spleen.*

The presence of internal—without any external—carbuncles was mentioned by several of the older authors (Bertin, Costa), and recently has been confirmed by the communications (adduced above) of von Wahl, von Recklinghausen, Buhl, Waldeyer, E. Wagner, W. Müller, and Münch. Likewise, the simultaneous appearance of internal carbuncles, in connection with anthrax of the skin, was recognized long ago (Fournier, Barez, Sanson, Rayer, Meier, Houel, and others). Blavot[1] indeed stated that the changes in the intestinal canal were nearly constant, and described them as black hemorrhagic infiltrations and pustular tumors, the summits of which were ulcerated, and concealed a yellowish detritus, surrounded by an inflammatory raised border.

The results of microscopic examination are of the greatest importance, and may be considered as pathognomonic in anthrax —at least where these results are positive.

To begin with the histological changes of the cutaneous carbuncles, Davaine, with Raimbert, was the first who demonstrated bacteria in them. Davaine[2] found the bacteria—after two or three days' development of the carbuncle—embedded chiefly in the centre of the pustule in the Malpighian layer, beneath the cortical layer of the epidermis. They were not distributed evenly, but formed little islands and groups, which were composed of a compact felting together of bacteria. At the periphery of the pustule the bacteria were found scattered among the epithelial cells. On the third day of development the bacteria constituted the exclusive and essential element of the tumor; after this they gradually insinuate themselves into the deeper layers of the skin, work their way into the vessels, and by means of the blood spread themselves through the entire organism. Virchow,[1] in a cutaneous carbuncle, as large as a silver dollar, which was extirpated on the twelfth day of its existence by Bardeleben found all the external parts of the pustule permeated by bacteria. They were found everywhere in the cellular elements, on the surface and in the hair bulbs, in the cells of the *rete Malpighii*, in the connective tissue, in the spindle-shaped cells, which were greatly enlarged and filled full of bacteria. These cells, regular in their outlines, and of a dull, shining appearance, bore a certain resemblance to granular cells. E. Wagner (l. c., p. 23), in an anthrax pustule which was extirpated by Thiersch on the second or third day of its development, and was of moderatesize, also found the central papillæ very friable, as much as two or three times enlarged in every direction, and so thickly permeated by bacteria that no other constituent of the tissue was recognizable microscopically. Many papillæ were filled with bacteria only in their upper parts, or very sparingly elsewhere, while these organisms were present in the capillaries in great numbers. Wagner, moreover, found a fibrino-purulent effusion separating the epithelial from the papillary layer. In many papillæ there was only a puriform infiltration. The deeper layers of the corium were also infiltrated with blood and pus, but no fungus could be recognized.

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[1] Considérations sur la pustule maligne. Thèse. Strassburg, 1863.

[2] Comptes rend., LX., p. 1296, 1865; Bulletin de l'Acad. de Méd., XXXIII., p. 620, 1868.

In like manner bacteria were discovered in anthrax pustules by Lancereaux, Féréol, and E. Bergmann.

As to the microscopical changes in anthrax blood, the characteristic bacteria have also been found in it by a number of observers, particularly by Davaine, Gayet, Stone, Buhl, Waldeyer. E. Wagner, and W. Müller. According to their conclusions and certain particular researches made in this especial direction (Buhl's case), the bacteria behave just as they do in anthrax of the domestic animals ; and if the pathogenic significance of these organisms could still in any way be called into question, yet after the careful investigations recently made into the intestinal forms of anthrax (especially by the last-named observers), doubt is hardly admissible any longer. So far as a judgment can be formed from the small number of cases thus far known, anthrax in man seems to be distinguished from that of the domestic animals essentially in these respects, that the bacteria are much less often so regularly distributed through the blood of man, and that they appear on the whole to be less numerous than in the blood of the domestic animals. In connection with the fact that in man the poison (the bacteria) remains much longer confined to the point of its entrance, this difference may, perhaps, be explained on the theory that the human organism affords far less favorable conditions for the increase and reproduction of bacteria than does that of the herbivorous animals.

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[1] *Franz Ritter*, Ueber den Milzbrand. Inauguraldiss. Berlin, 1872, p. 29.

Besides the filamentous bacteria, spherical bacteria are constantly found in the blood, or the latter exist alone, and are limited to certain vascular areas, as was shown by Buhl, E. Wagner, and W. Müller. The blood, moreover, shows a more or less pronounced leucocytosis, and the white corpuscles are very often granular, due perhaps to the presence of spherical bacteria which have penetrated within them. The red blood corpuscles hardly ever evince the well-known tendency to collect into rolls.

The histological changes found in the internal carbuncles, as well as those found in the serous and sero-hemorrhagic infiltrations, are due to the presence of the fungus, to cellular œdema, and to an infiltration of serum and blood. Anthrax bacteria are found (in intestinal anthrax) in the cellular tissue of the intestine, in the blood and chyle vessels, in the follicles of Lieberkühn, in the mucous and submucous tissues, and in the greatest number in the swollen, hemorrhagic, infiltrated mesenteric glands. At the same time, in these "fungus-stiffened" parts, a secondary cellular œdema is often found, which goes on to a positive fibrino-purulent infiltration. Furthermore, bacteria are found in the spleen, at the points of hemorrhagic effusion in the different organs, especially the brain (E. Wagner), and also, though in smaller number, in the serous effusion in the serous cavities.

Finally, in the great parenchymatous glands—liver and spleen—the microscope reveals the well-known changes of cloudy swelling and parenchymatous inflammation.

Diagnosis.

In anthrax districts the diagnosis of anthrax in man is not difficult, especially when the point of entrance of the poison is situated upon the skin. Likewise in manufactories and establishments where animal products are worked up (especially hair, wool, bristles, and hides), every cutaneous carbuncle awakens the suspicion of anthrax, and a diagnosis is readily made from the history of the case. The latter receives its chief support from the social position and place of abode of the patient.

On the other hand, in intestinal anthrax, which is much more rare, it is difficult to make a diagnosis from the symptoms and appearances alone. In consideration, however, of the rapid onset of the disease, its acute course and stormy manifestations (diarrhœa, vomiting, cyanosis, convulsions, collapse), and the business of the patient, an accurate diagnosis is possible. A simultaneous appearance of carbuncular or œdematous affections of the skin naturally goes far to assist the diagnosis.

Microscopic examination of the blood will only furnish conclusive evidence when the characteristic filamentous bacteria are found in it; but in the earlier stages of the disease, and even later on, they may be wanting. They only have a positive value; while no conclusion can be formed from their absence as to the non-existence of anthrax.[1]

On the other hand, microscopic examination of the cutaneous carbuncle is imperatively necessary in every doubtful case. Judging from the data of a large number of such examinations, carried out by competent observers, the presence of anthrax bacteria in true anthrax carbuncle can with certainty be depended upon as pathognomonic. Likewise in anthrax œdema, according to Raimbert, bacteria may be found in the vesicular prominences, thus very much lightening the difficulty of diagnosis. Should no bacteria be found in the excised malignant pustule, we are justified in considering it as a spurious case, as a common carbuncle.

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[1] I entirely agree with *E. Wagner* where he says that, in microscopic examinations of the blood, only the fungous filaments—the characteristic *Bacillus anthracis*—can be considered as pathognomonic; yet *Leube* made a diagnosis in one case from the presence of spherical bacteria in the white blood corpuscles. In a drop of blood from a case of intestinal anthrax examined twenty-four hours before death, *E. Wagner* failed to discover any bacteria.

In many cases the inoculation of animals may be resorted to as an aid to diagnosis. The most appropriate animals are rabbits, guinea-pigs, goats, or sheep; but here also only a positive result is conclusive—not so a negative one.

Inoculations from anthrax of man upon animals, with positive results, have been already made by Greese, Wendroth (upon sheep), Davaine, (upon guinea-pigs), Gayet (upon rabbits), and, recently, by W. Müller and Schuster (upon rabbits, and from these again upon rabbits, guinea-pigs, and cats). On the other hand, Hübner (in dogs) and Neyding (rabbits) got negative results.

In relation to the morbid processes, which may be mistaken for anthrax carbuncle, the simple carbuncle[1] of the surgeons must first be mentioned. This is a circumscribed necrotic inflammation of the skin, in which a number of furuncles occur so near each other that the intervening skin sloughs. As distinguished from this, the anthrax carbuncle proceeds from a sharply defined centre, extends widely, and in its further course is attended by general symptoms.

In anthrax carbuncle, moreover, there is an early superficial eschar, which is surrounded by a raised vesiculated border. Furthermore, its centre is somewhat depressed, the slough is more dense, the swelling very little sensitive, and the development quicker than in simple carbuncle. The latter has no raised vesiculated border; its centre is prominent; the slough is less tough, the tumor painful, the neighboring œdema redder, or of a livid color, the entire process more indolent.

Finally, the seat of the lesion is of importance. While anthrax carbuncle preferably occupies a portion of the body habitually uncovered, simple carbuncle generally chooses the skin of the back and neck, and in its mature state is riddled superficially by numerous purulent openings.

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[1] That *Korányi* should prefer to consider this non-contagious form of carbuncle as anthrax (l. c., p. 180), and anthrax carbuncle as carbuncle, appears to me to be unfortunate, and only liable to produce confusion.

Anthrax carbuncle is distinguishable from the bites of insects in that the latter have a small yellowish spot on the summit of the papule, which is wanting in the former. It is not difficult to distinguish an anthrax carbuncle from a furuncle. The rapidly appearing raised red border is wanting in furuncle.

Carbuncles accompanying glanders are usually multiple, smaller, accompanied by intense general symptoms. In noma, the sloughs are more extensive, softer, discolored, and shreddy. The plague-boil (Pestkarbunkel) is generally found on covered portions of the trunk and extremities, is especially painful, and, for the most part, multiple.

For the diagnosis of malignant anthrax œdema, we refer to its description already given, as well as to the published results of Raimbert's investigations, who found bacteria in the serum of the vesicles of the raised border.

In discussing prognosis and treatment, we shall have an opportunity to look more closely into the value of a correct diagnosis of anthrax in man; and, finally, for the establishment of a diagnosis we must recognize the fact that a skilled microscopic examination of the carbuncle and the detection of bacteria are absolutely essential.

Prognosis.

The indications for the prognosis of anthrax in man are, on the one hand, the point of time at which treatment is resorted to, on the other, the way in which the infection has taken place.

In external infection, when medical aid is sought early, and a rapid and accurate diagnosis is accompanied by energetic treatment, the prognosis is in general favorable. The fact that the physicians of anthrax districts have favorable results to report, is due incontestably to the fact that the disease there is reasonably well known, medical aid is not sought too late, and further, that these experienced observers are in a position to make a diagnosis quickly and without difficulty. Lengyel and Korányi out of 142 cases of anthrax carbuncle, lost only 13, = 9 per cent. Nicolai had still better results. Out of 209 cases he lost only

11, = 5 per cent. Weiss[1] cured malignant pustule in nine cases by energetic local treatment.

Were we in a position to give the statistics of sporadic cases of anthrax—occurring outside of anthrax districts—the mortality would necessarily have to be placed much higher, at least at from 30 to 40 per cent.

Menschel[2] observed in twenty-four cases of anthrax in man, produced partly by eating diseased meat, and partly by external infection, that five died; these, however, had summoned medical assistance too late, or not at all. Of nine cases collected by Budd,[3] eight ended fatally. Among my own observations I know of two cases of[4] external anthrax infection, in which the fatal termination was in one attributable to the fact that medical aid was sought too late, in the other undoubtedly to an error in diagnosis.

The prognosis in intestinal anthrax, after internal infection, is far worse. Recovery in any case is very rare.

Judging from the reported cases, it may be stated that with correct diagnosis and energetic local treatment—especially when the latter is instituted before the appearance of general symptoms—the prognosis is very favorable. In very few diseases, therefore, is the responsibility of the physician so great as in this.

Treatment.

The prophylaxis of anthrax in man is naturally the same as in the case of the domestic animals, and we refer to what has been already said on that subject. We must remark here, that those authors who consider the legal enactments which are in force in most European states as being too stringent, evidently have an entirely faulty conception of the essence of anthrax and its methods of transmission. These enactments are, however, for various reasons, enforced and carried out for the most part in a very inefficient manner. It is indeed inconceivable for what other reason, than that above given, these authors are willing, in the case of animals that have been affected with the disease, to countenance the use of their hides and bodies for various purposes, and of their flesh for food.

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[1] Bayer. ärztl. Intelligenzblatt, No. 25, 1869.

[2] Preuss. Medicinalzeitung, 1862, p. 180.

[3] British Med. Journ., Jan. 24, 1862.

[4] Zur Pathol. des Milzbrands. München, 1872, p. 109. Besides the case there communicated, I have recently observed a second similar case, where the fatal termination could with great certainty be ascribed to false diagnosis and bad treatment.

As I have already in another place endeavored to make clear and distinctly to prove, it is necessary that there should be a particularly stringent prohibition against eating the flesh of diseased animals, not only on account of the fear of direct infection by eating, but also from the serious danger which attends the slaughtering of animals and the preparation of their flesh for eating.

In anthrax districts, moreover, it would be advisable to spread abroad a general knowledge of the danger of the disease and its methods of propagation; this should be done in such a clear and simple manner that all could understand it, and (as Borstieber has proposed, l. c.) suitable instruction should also be given certain handicraftsmen (workers in wool, in hat factories, and in tanneries) as to the means by which anthrax is spread, and the value of an early application of caustic (carbolic acid) —which latter should be kept constantly on hand in manufactories and workshops.

I have repeatedly had an opportunity of convincing myself that infection may easily be averted by taking the necessary precautions when coming into contact with diseased animals, and in the necessary handling of cadavers (for example at autopsies).

The most essential point in the treatment of anthrax in man, where the infection has taken place externally, is a *thorough destruction of the local affection.*

After infection has occurred, or when there is any suspicion of it, the point implicated should be thoroughly cauterized, most appropriately with concentrated carbolic acid, caustic potash, or fuming nitric acid. Should an actual anthrax carbuncle be already present, the treatment to be recommended unconditionally in most cases is *extirpation with the knife, followed by cauterization.* Instead of excision, deep incisions (preferably crucial) may be resorted to, followed by cauterization. In crucial incisions, the flaps may be trimmed. Various agents may be

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used successfully as cauterants. Those most usually employed are fuming nitric acid, caustic potash, and of late years carbolic acid. A number of other caustics (sulphuric acid, nitrate of silver, acid nitrate of mercury, butter of antimony, corrosive sublimate, ammonia), as also the actual cautery, work with less certainty. Simple cauterization does not usually answer so well as when extirpation or incision has preceded it.

The energetic destruction of anthrax pustules is also often successful even in the later stages, indeed after important general symptoms have appeared. The cauterization may be then often repeated with advantage—even two or three times—until the raised border ceases to appear. Generally a single thorough cauterization is sufficient to effect a cure. After excision and cauterization, the œdema in the neighborhood of the anthrax pustule, as a rule, promptly disappears. As a precautionary measure, however, a reapplication of the caustic is advisable. Hopes of a recovery may still be entertained, even after constitutional symptoms have appeared, provided these be not too severe.

As the slough may in any case give rise to septic infection, it is further advisable to put on an antiseptic dressing (lint soaked in chlorine water, or, better still, in carbolic acid), which latter is to be followed by warm poultices, preferably containing a little carbolic acid, which hasten the formation of the line of demarcation, and the separation of the slough. In this stage local stimulation is indicated (spirit of camphor, tincture of myrrh, stimulating ointments).

If general symptoms have already appeared, large doses of quinine render valuable service, especially when the cauterization has been made too late, or is insufficient. By analogy with the undoubtedly good results of the use of carbolic acid in anthrax of animals, the latter is probably of value internally administered, and indeed simultaneously with the quinine (in the course of a day fifteen grains of carbolic acid, and thirty of quinine), as it has been recently employed with success by Leube in a case of anthrax.

In other respects the treatment should be tonic and sustaining; the diet should be strengthening and easy to digest (wine).

When there is considerable œdematous swelling of special portions of the body, and threatening gangrene, deep incisions are appropriate, penetrating into the yellow, infiltrated connective tissue, and these should be dressed with disinfectants (carbolic acid).

In intestinal forms of anthrax, the internal treatment is the same as that for the general symptoms occurring after external infection. Carbolic acid and quinine are also indicated here. Cinchona, iron, wine, are to be recommended as tonics, and an appropriate diet as well. When it is certainly known that flesh from diseased animals has been eaten, a powerful emetic may be of value.

HYDROPHOBIA.

LYSSA. RABIES.

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Compare Monographs of *Virchow* (Handb. der spec. Path. u. Therapie, B. II., p. 342, 1855), *Von Reder* (Pitha und Billroth, Handbuch der Chirurgie, B. I., 2, p. 116.

1870), as also the treatises on the special pathology of domestic animals, by *Röll*, *Haubner*, *Hering*, *Spinola ;* also *Bruckmüller*, Pathol. Zootomie. Wien, 1869.—*Schmidt*, *Maximilian*, Zoologische Klinik, B. I., 2 Abth. Die Krankheiten der Raubthiere, p. 322–376. Berlin, 1872.

HISTORICAL NOTICE.

THE antiquity of hydrophobia is not precisely known. According to the results of comparatively recent investigations (Marx), the earliest descriptions of this appalling malady have uite a mythical character.

The first unmistakable account of hydrophobia is found in Aristotle († 322 before Christ): "Dogs suffer from rabies. This induces a state of madness, and all animals which are then bitten by them are likewise attacked by rabies. This malady is fatal to dogs, and also to other animals that have been bitten by a mad dog, with the exception of man." The genuineness of the last passage, however, which fails to recognize hydrophobia as occurring in man, has been frequently questioned.

About the same time we find hydrophobia alluded to by Xenophon, Epicharmus, and Democritus (the laughing philosopher). By the latter the malady was described as an inflammation of the nerves, and classed with the severe spasmodic diseases allied to tetanus. On the other hand, it is extremely doubtful whether Hippocrates was acquainted with hydrophobia.

To numerous later authors, poets and historians, hydrophobia was a well-known disease, mention having been made of it by Andreas of Carystos, Gaius, Themison, Eudemus; also by Virgil, Horace, Ovid, Plutarch (130 before Christ), Pausanias, and Pliny the Second. Most admirable accounts of the malady are contained in the writings of Cornelius Celsus: "If the wound produced by the bite be not promptly and energetically treated, hydrophobia ensues—a most deplorable malady, one in which no hopes of recovery can be entertained. The virus should be withdrawn by means of a dry cupping-glass, while the wound, if its situation permit, should be treated with the actual cautery. If this be impossible, then other caustic agents should be applied, and the part should be bled." A detailed account of hydrophobia is also given by Dioscorides, who pronounces the affection frightful, there being no possibility of saving the life of those attacked. He insists upon the importance of prophylactic measures (caustic applications, the actual cautery, scarification, and amputation), and describes the varying period of the stage of incubation.

Galen (131–201 after Christ) declares hydrophobia to be the worst of all diseases, and recounts with great accuracy numerous phenomena attending it. As a protection against infection, he recommends excision of the wound.

Cælius Aurelianus—probably a contemporary of Galen—celebrated for his truthful and life-like representations of diseases, treated all the important questions relating to hydrophobia with wearisome accuracy: the modes of origin,—spontaneous as well as those depending upon communication; the organs serving as absorbents of the poison; the localization of the disease; the parts principally attacked; the character of the disease; the differential diagnosis; the points whereby it may be distinguished from inflammation of the brain and mania; the time of outbreak; the course; and, finally, the treatment.

With Galen and C. Aurelianus, independent observations concerning hydrophobia ceased for a considerable length of time. With few exceptions (Rhazes, 922; Avicenna, 1036), the authors of many succeeding centuries contributed little or nothing to the previous knowledge of the disease.

The disease was also known to the ancient inhabitants of India, to the Egyptians, and the Israelites.

The fallacious theories and hypotheses regarding hydrophobia which have obtained credence with the public, and medical men, and which to a very great extent prevail to this day,—these preconceived notions, originating a thousand years ago, are justly designated by the terms here applied to them. This may be shown by the fact that in our own day, about the same characteristic features are ascribed to hydrophobia that were accorded to the disease by the writers of two thousand years since; it being asserted now, as formerly, that dogs affected with rabies present, as prominent symptoms, reddened eyes, a drooping tail, foaming mouth, a projecting tongue, etc.

After the lapse of so many centuries, during which no advance was made in our knowledge of hydrophobia, notwithstanding the large amount of literature on this subject, there were at last reported, towards the end of the last century, a series of better investigations by different observers (Chabert, J. Hunter), while recently a more exact knowledge of hydrophobia has been acquired—chiefly through the researches of the Englishmen Meynell and Youatt, as well as by the extensive experiments of Hertwig.

Numerous other observers also, by means of experimental, as well as of clinical and historical studies, have served to increase our knowledge of hydrophobia. Among these names may be mentioned Magendie, Breschet, Rust, Greve, Krügelstein, Blaine, Faber, Schrader, Pillwax, Bruckmüller, Bouley, Marx, and others; furthermore, Virchow and Reder, as well as different veterinary pathologists.

HYDROPHOBIA IN ANIMALS.

Hydrophobia, which prevails chiefly among animals of the canine species (dog, wolf, fox, hyena, jackal)—often as an epizootic—is an *acute infectious disease*, coming on in the form of a *functional disturbance of the central nervous system, with an absence of all gross anatomical changes*, and distinguished from other similar diseases by its *long and extremely variable period of incubation*. The specific *materies morbi*, the intimate nature of which is unknown, belongs to the endogenous class of specific poisons, is propagated only in infected animal organisms, is fixed, non-transportable (nicht verschleppbar), and never volatile. As in the case of genuine inoculable diseases, hydrophobia originates only through infection, it being essential that the virus should come in contact with an abraded portion of the skin or mucous membrane, in which respect it bears the closest resemblance to syphilis. The communication of the poison is effected almost invariably by means of the bite of a rabid or infected animal, whereby the poison is implanted directly in the animal. The existence of a spontaneous, or so-called miasmatic development of hydrophobia, which is extensively credited, is entirely unproved. The disease is transferable from animals of the canine species to man and all domestic animals.

Etiology.

Although for a long time authorities have agreed that the disease in by far the greatest number of cases arises from inoculation by means of the bite of a rabid animal, it has at the same time been admitted by many, that a spontaneous or primary origin of the disease might also be possible to animals of the canine species (dog, wolf, fox, jackal, badger).

If inquiry be made respecting the cause of the alleged spontaneous cases of hydrophobia, the reply will be by no means satisfactory. It was believed that a peculiar miasma formed a direct, active, causative factor, and to this were referred especially the epizootic outbursts of hydrophobia. In respect to the etiology of the disease in dogs, certain influences are frequently cited as predisposing and accidental causes; such, for instance, as intense heat or cold, want of drinking water, domestication, training, physical deterioration induced by their artificially acquired modes of life, which are quite contrary to their nature as beasts of prey. Furthermore, the stimulated but ungratified sexual desire has been selected as the exciting cause, and in this connection the disproportion existing in the number of male and female dogs[1] was thought to be especially significant. Finally, certain breeds—especially those of a vicious disposition, overfed dogs, and curs were said to evince an especial affinity for the spontaneous form of the disease.

It is not necessary to enter into a detailed enumeration and description of all the influences that have hitherto been supposed to serve as causes for hydrophobia, and we will therefore content ourselves with the consideration of the more important questions relating to the matter.

When hydrophobia prevails as an epizootic—a phenomenon that is often quoted in support of its spontaneous origin—there can almost always be detected, upon careful examination, one or more central points which serve as distinct depôts or centres of infection. We know, moreover, that the spread of the epizootic is arrested by the larger rivers.

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[1] In Central Europe the females form only from ten to fifteen per cent. of the entire number of dogs.

Schrader relates that during the prevalence of hydrophobia in Hamburg and vicinity (1852–1853), no cases were observed upon the islands of the Elbe, although upon both sides of the river instances of the disease were of frequent occurrence. Similar facts have been collected by Virchow (loc. cit., p. 358), all of which, coinciding fully with the results attained by a study of the geographical distribution of hydrophobia, afford powerful arguments against its spontaneous development.

Furthermore the mere epizootic and enzootic appearance of hydrophobia indicates in itself nothing more than the existence of a primary genetic cause; whereas we know, on the other hand, that the infectious diseases themselves appear almost invariably in the epidemic and endemic form.

As to the hypothesis that changed nervous influences, such as extreme domestication and training, serve as causative factors in the primary development of hydrophobia, it is simply necessary to state that the disease prevails also in those localities where dogs roam at large, for instance in the East, where they pass their life in freedom from all control. I willingly admit that the above-named abnormal conditions of life, and the unnatural mode of living may tend to predispose dogs to mental and nervous disturbances, and may also play a certain part in predisposing these animals to traumatic rabies; but these conditions never suffice to produce a development *de novo* of the disease.

Attempts to produce hydrophobia artificially by starving dogs, have been ineffectually made by Radi and Bourgelat.[1] The same negative results were obtained by Ménécier,[2] who did not sec a single instance of hydrophobia among 160 dogs that had been poorly fed and kept. Pillwax observed, during onc of the severer epizootics in Vienna, that the greater number of affected dogs belonged to owners in good circumstances in life, enjoying, therefore, for the most part, good care and food.

The extremely disproportionate occurrence of hydrophobia in male animals has likewise been attributed to one of the causes above alluded to, namely, to unsatisfied passion, —to the sexual excitement, which, in the greater number of male dogs, is being constantly stimulated but never gratified. According to the evidence of statistics, however, the total number of mad dogs is divided between the two sexes in a ratio nearly equivalent to the numerical relation of the two sexes to each other; and, on the other hand, castrated dogs are just as liable to contract the disease as other dogs.

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[1] *Chabert*, p. 73.

[2] Gazette des hôpitaux, No. 25, 1869.

Of 267 cases of hydrophobia, observed by Schrader in Hamburg in 1852–3, 256 occurred in male dogs, ten in females, and one in a castrated dog. Of fifty-four pronounced cases of hydrophobia occurring in Denmark from 1855 to 1857, there were found, according to Tscherning, four male and three female dogs that had been castrated, equivalent to a percentage of thirteen. Furthermore, the fact of the occurrence of hydrophobia in wild animals (wolf, fox)—among which the numerical relation of the males to the females is a natural one, no obstacle being interposed to the gratification of the sexual appetite—affords proof of the fallacy of the above hypothesis, as does also the circumstance that hydrophobia does not prevail in all places and continuously, but appears at certain times only, and is then confined to a certain territorial district. Greve (loc. cit., Bd. I., p. 152) attempted to produce experimentally in this manner hydrophobia, but without success. In the case of wild beasts, that are kept in close confinement in menageries and zoological gardens, to whom the gratification of the sexual appetite is for a long period of years denied, hydrophobia is never seen to arise.[1] Some individuals have been so thoroughly convinced of the significance of the suppressed sexual passion as a causative element in the production of hydrophobia, that they have advocated the castration of all dogs not intended for breeding purposes.

The theory so frequently advanced, that even the bite of an angry dog is sufficient to produce hydrophobia, will be found upon *à priori* grounds to be extremely improbable, since, were this the case, almost every dog-bite would have a lyssogenous effect, inasmuch as dogs are, as a rule, apt to bite only when irritated and enraged.

The relation thought to exist between the excited sexual passion and hydrophobia is analogous to that of numerous other alleged causes of the malady, such for instance as tape-worm. It is indeed true that we seldom fail to find tape-worms in the intestines of rabid dogs; but these parasites are generally observed in the majority of all dogs. Symptoms similar to those of hydrophobia may indeed, under certain conditions, be induced by parasites of this nature, just as by various other causes, but the infectious hydrophobia can never be so produced.

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[1] *Schmidt*, Zoolog. Klinik, I., p. 362.

Finally, to prove the spontaneous origin of hydrophobia, the occurrence of the disease in wolves, foxes, and cats has been cited ; this having been induced in the latter by depriving them of their young, or by subjecting them to painful burns. In cases, however, where hydrophobia has prevailed, in the form of an epizootic, such as has raged for years among foxes throughout entire provinces or districts (for instance in Carinthia from 1866 to 1872), no other etiological condition could be discovered than the continual infection from fox to fox (Oertl). The attempt to elucidate the cause of such diseases by tracing a connection between them and external influences, other than those above mentioned, or by referring them to a miasma, is futile, for the following reason, namely, that it frequently happens that during the prevalence of such epizootics no cases of hydrophobia occur among dogs. The original source of these epizootics of hydrophobia is the bite of rabid dogs, and, on the other hand, hydrophobia may be communicated to the dog by wild animals of kindred species.

Dogs living in the mountains of Switzerland (herdsmen's or mountain dogs) are said to frequently contract the disease from rabid foxes. At those times when rabies rages among dogs, rabid foxes are usually found, with whom the epizootic, it is true, may have originated (v. Tschudi[1]); Köchlin (loc. cit., p. 14) reports a case of the communication of hydrophobia from a fox to a dog. Oertl (loc. cit.) relates that during an epizootic of hydrophobia among the foxes of Carinthia, raging from 1866 to 1872, numerous animals, especially dogs and other domestic animals, were bitten, as were also two men.

A further proof of the alleged spontaneous origin of hydrophobia was claimed to have been found in the circumstance that neither wound nor cicatrix could be detected upon the smoothly shaved bodies of dogs that had died from this disease. But, inasmuch as the smallest erosions, such as heal without leaving any scar, are sufficient to admit the virus into the system, it must be admitted that this argument will not bear a close scrutiny.

Many cases of alleged spontaneous development are obviously to be explained by this circumstance, that the bite of an infected

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[1] Das Thierleben der Alpenwelt, 5 Aufl. Leipzig. 1860, pp. 357 and 525.

—though apparently healthy—dog, when inflicted during the period of incubation, has even then the power of communicating the disease.

Thamhayn (loc. cit., p. 341) has collated nineteen cases, occurring in the human subject, in which dogs, to all appearances healthy, but which subsequently became rabid, produced by their bite hydrophobia, the result being fatal in eighteen of these cases. Fessler[1] relates the following case, observed at Bamberg: A dog, whose penis was cut off during the act of coitus, died in the course of a few days from grangrene of the wound, without having manifested any symptoms of hydrophobia. His master, who had been bitten by him, was seized in the course of a few weeks with hydrophobia, and died.

The communication of rabies in any other manner than by a bite, is indeed extremely rare. Infection by coitus, which, it is pretended, takes place in the human subject, has not been shown to occur in the case of animals, although there must be sufficient opportunity for this mode of infection; rabid bulls unite with cows, for instance, without infecting the latter.

An instance of congenital hydrophobia is related by Callinac:[2] A cow, which, forty-eight days before being attacked by the disease, had been bitten by a rabid dog, gave birth, while suffering from hydrophobia, to a calf. The calf was likewise seized with hydrophobia, although another cow had been substituted for it to suck from.

No instance of the transference of the poison of hydrophobia by intermediate vehicles is as yet known to have occurred, it being either not at all, or at all events only to a very slight degree, transportable. If minute particles of the virus suffice to propagate infection, it may be inferred, judging from analogy with other infections diseases (for instance, malignant pustule), that possibly certain parasites (fleas and lice), which are nourished by the blood of the dog, and which hardly any dog is free from, may transfer the poison by means of their blood-drawing apparatus, and thus produce inoculation.[3]

The communication of hydrophobia from one animal to another, by the consumption of the meat or milk of rabid animals, is extremely rare. As a rule, food of this kind is taken into the stomach without ill effect.

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[1] Wochenschrift für Thierheilkunde, 1872, p. 358.

[2] *Matton, Donat.*, Considérations sur la Rage. Strassburg, 1862.

[3] The fact of the communication of small-pox by flies can hardly be questioned; a case of vaccination by the medium of a flea, was a short while ago reported in England. (Lancet, June 22, 1872.)

In conclusion, the views above expressed as to the mode of origin of hydrophobia may be summarized as follows: Hydrophobia, like all other infectious diseases, never arises spontaneously, but requires, as an indispensable antecedent causative factor, an infection, by the introduction into the organism of the specific *materies morbi.* All the etiological conditions, such as the season of the year, temperature, want of freedom, suppressed sexual appetite, age, sex, and race are to be regarded neither as direct nor predisposing causes. Very many of the best observers, recent as well as old, such as Blaine, Youatt, Magendie, Dupuytren, Breschet, furthermore Schrader, Adam, St. Cyr, Peuch, Boudin, Virchow, and others reject the theory of spontaneous development,—a theory which has been adopted in a great measure as a matter of convenience, until additional and more exact investigations shall have been made.

Predisposition.—This is, on the whole, moderate. By artificial attempts at inoculation, from two-fifths to two-thirds of the animals inoculated or bitten were infected.

Hertwig experimented upon 30 dogs, some of which he inoculated with saliva taken from rabid dogs, while others were allowed to be bitten by such animals. In eleven instances—equivalent to 37 per cent.—he obtained positive results, whereas 19 of the inoculated and bitten animals remained unaffected.[1] Renault caused 99

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[1] The important experiments of *Hertwig* may be summarized as follows:—Sixteen inoculations with saliva (taken from a rabid dog either during life or soon [fifteen hours] after death) produced positive results in six cases.

Six inoculations with saliva obtained from the cold cadaver, from twenty-four to forty-eight hours after death, resulted negatively in each case.

Seven inoculations with portions of the substance of the salivary glands produced, in one instance, a positive result.

Fifteen inoculations, by means of the bite of mad dogs and by natural inoculations, produced, in five instances, positive results.

Six inoculations with portions of the nerve tissue of rabid dogs were all negative.

Twenty-three experiments made with food smeared with the saliva and blood of rabid dogs were all negative.

Five attempts at inoculation by means of intermediate vehicles (placing the subject in a stall where a mad dog had been previously confined) were negative.

Hertwig, in tabulating the results of his attempts at inoculation, affirms that, from different animals (dogs, horses, and sheep) to be bitten by rabid dogs. Of these, 67—equivalent to 67 per cent.—became rabid, while the remainder continued healthy, although they remained under observation for at least one hundred days. In Würtemberg, from 1864 to 1867, out of 943 animals, which were wounded by dogs that were rabid, or suspected of being rabid, or particularly given to biting, 28, or 3 per cent., were seized with rabies. It is obvious that the favorable result in this instance is attributable principally to the fact that merely savage dogs were included in the estimate. According to Youatt, two-thirds of those dogs which are bitten by rabid dogs contract the disease. Of 137 dogs that were bitten by mad dogs in the years 1823 to 1827, and subsequently kept under observation at the veterinary school at Berlin, six died from hydrophobia, while the rest remained healthy (Hertwig, loc. cit., p. 145).

From causes that cannot be explained, inoculation is often unsuccessful, even when performed under the most favorable circumstances. Many dogs resist all infection; nine different attempts, in the course of three years, to inoculate the famous poodle of Hertwig, were ineffectual, while other dogs in whom the same poison was implanted were infected. In the veterinary school at Lyons, a dog which had been bitten, experimentally, four different times, remained unaffected. Other dogs resist two, three, and even four attempts at inoculation, and are finally infected at a subsequent trial. According to the experiments of Ménécier, a rich feeding of the dogs that have been infected favors the outbreak of the disease, while, on the other hand, it is retarded by poor nourishment.

That hydrophobia occurs most frequently among dogs between the ages of one and six years (Pillwax) is manifestly due to the fact that the majority of dogs are under six years of age.

Before proceeding to review our limited knowledge of the

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fifty-nine experiments, he obtained fourteen positive results. This number, however, should not be taken, as it often has been, as a basis for a general estimate of the disposition to contract the disease, for there were included in this calculation inoculations with blood, with saliva obtained a long time (twenty-four to forty-eight hours) after death, with the substance of the salivary gland, and with portions of the nerve substance, all of which, in thirty attempts, produced only three positive results.

Moreover, the low percentage of positive results yielded by *Hertwig's* experiments are to be attributed in part to the fact that they were repeated upon dogs manifesting no affinity whatever for the virus; his own poodle, for instance, having been selected no less than nine times.

nature and mode of action of the virus of hydrophobia, a few words must be devoted to those who deny altogether its existence, regarding it either as a phase of another disease (tetanus, anthrax, typhus), or else explaining it—at least in the case of man—as being a simple psychosis in consequence of anxiety resulting from a bite.

The denial of the existence of hydrophobia as a specific disease, a theory that has recently been adopted by Maschka[1] and Lorinser,[2] does not possess the merit even of novelty, for the existence of hydrophobia, as a disease *sui generis*, as well as the existence of a specific virus, was denied in France by Bosquillon[3] as early as the latter part of the last century. According to their views, the symptoms are to be ascribed to fright, or to the local injury. In like manner Girard and J. Simon (1819) described hydrophobia as an imaginary disease. R. White[4] regarded hydrophobia as nothing more than an ordinary inflammation of the œsophagus, the stomach, and the muscles of respiration, and went so far as to deny utterly, not only the specific character, but also the infecting property of hydrophobia. In order to prove the latter, he inoculated several cats, rabbits, and other animals, and finally himself, from two rabid dogs—all without results. It is hardly necessary to add that these negative results, as compared with the numerous positive effects following inoculation, and with simple clinical experience, are entitled to no weight, and are valuable, at most, only as illustrations of foolhardiness indulged in with impunity. Another writer also, Franque (loc. cit.), having at first opposed the idea of the primary existence of hydrophobia, and of a specific contagion, after being made acquainted with the experiments of Hertwig, renounced his views, and admitted the hydrophobia of foxes to be a specific disease.[5]

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[1] Prager Vierteljahrsschrift f. wiss. Heilk., 1871, III., p. 1.

[2] Wien. med. Wochenschrift, 1865, Nos. 19–21.

[3] Mémoire sur la cause d'hydrophobie, vulgairement connue sous le nom de rage. Paris, 1802.

[4] Froriep's Notizen für Natur und Heilkunde, 1826, Nos. 264, 266, und 268.

[5] Geschichte der Seuchen, die in dem Herzogthum Nassau seit dem Ende etc. geherrscht haben. Frankfurt a. M., 1834, p. 239.

All these attempts to dispute the existence of hydrophobia are not easily comprehended by such persons as have had occasion to witness the disease, with all its horrors, in cases of animals and men. As these hypotheses have not been adopted to any great extent, either by professional men or the public, they may, on the whole, be pronounced tolerably harmless; nevertheless they might, under certain circumstances, be conducive to very great injury.

As Virchow has already forcibly stated, the doctrine of the spontaneous development of hydrophobia contributed most of all to involve in doubt the specific character of the disease. On the other hand, it is well to consider that the diagnosis of hydrophobia, especially in the case of animals, is extremely difficult and doubtful; that numerous cases are designated by that term which are not entitled to it. Finally, as regards the human subject, as will be seen later, there can be no question as to the existence of hydrophobia, which, like certain affections of the mind, may present diagnostic difficulties, but its existence as a specific disease should not on that account be denied.

That the rabies of dogs has no connection with tetanus, anthrax, and similar affections, it is hardly necessary to discuss. Tetanic symptoms, such as are now and then observed in cases of hydrophobia in the human subject, are never known to occur in the case of dogs.

NATURE AND MODE OF ACTION OF THE VIRUS OF HYDROPHOBIA.

The specific infecting principle of hydrophobia is absolutely unknown. Neither chemical nor microscopic analyses of the saliva of mad dogs have as yet given any clue to its detection. The virus is reproduced only within the diseased economy, never outside the same, and belongs therefore to the endogenous morbific agents. It is distinguished from the other chemical and morbid poisons principally by this circumstance, that it remains within the organism for weeks, and even months, without producing any morbid symptoms whatever. In its action upon certain organs of the central nervous system, upon the centre of the mechanism involved in deglutition, upon the centre of the respiratory system, and the nerve centre influencing spasmodic contractions, its action is analogous to certain nerve poisons of a vegetable or chemical nature.

The virus of hydrophobia is contained in the saliva and foam of the affected animal, also in the blood and salivary glands, and possibly also in still other solid and fluid portions of the body ; *it is always fixed, never volatile.*

It is probably capable of infection even during the stage of incubation, and also continues active for some time after death —hardly longer, however, than twenty-four hours.

By natural or artificial inoculation, the virus, either by penetrating a denuded portion of the skin or external mucous membrane, or an actual wound, may be transferred to numerous other species of animals and to man, and reproduce (under certain conditions depending upon individual predisposition) a fatal hydrophobia.

The manner in which the wound is inflicted, as well as the psychical condition (fear) of the person or animal bitten, exercises, as a rule, no influence in the production of the disease.

Inoculations performed with saliva taken from a rabid dog after death are often without effect. When brought in contact with the unabraded mucous membrane of the digestive canal—in connection with the food—the virus is innocuous. In twenty-two experiments of this kind, made by Hertwig, the results were invariably negative. Out of eleven inoculations with the blood of rabid dogs, taken partly from living animals, partly from those that had just died, Hertwig obtained positive results in only two instances. Six inoculations with nerve tissue yielded invariably negative results.

Whether the bite of a mad dog shall be followed by infection, or not, depends, apart from the individual predisposition, upon accidental conditions, especially upon the circumstance whether the bitten part is protected by hair or other covering, whether the saliva is wiped off before the teeth come in contact with the skin, etc.

We have no accurate knowledge as to whether the virus of hydrophobia possesses a variable intensity, or virulence, depending upon the individual from which it is obtained. It is very generally asserted that the so-called sullen hydrophobia has a less infectious property than the violent species of the malady.

Nevertheless, it sometimes happens that an inoculation derived from a dog affected with the rabid form may produce the sullen form, and *vice versâ*.

There can be no doubt that the virus may be reproduced within the body of a person or animal infected, so to speak, second in order. According to the experiments of Rey (1842), it retains its infecting power down to the fifth generation. From rabid herbivorous animals, as well as from man, the disease may be communicated back to dogs.

The experiments of Hertwig, tending to show that the virus is inactive when brought in contact with the unabraded mucous membrane of the digestive canal, are confirmed by the fact, demonstrated by numerous experiments, that *the milk and flesh of rabid animals* (*dogs*, *sheep*, *cattle*) *may*, *as a rule*, *be consumed by man and animals without any ill effect.* Gohier alone states that he has seen hydrophobia produced in a dog by eating the flesh of a rabid dog; he has also seen it occur in the same animal from eating the flesh of a rabid sheep.

Hertwig carried out his important experiments with infected food in a great variety of ways: at one time he simply introduced the saliva and mucus of a rabid dog into the mouths and throats of healthy animals; at another he injected water mixed with virulent saliva into the throat and stomach; he fed dogs with small pills composed of meal, mixed with infected saliva and mucus, and also spread meat and bread with the saliva of mad dogs (both living and dead), adding a certain amount of warm blood also taken from rabid dogs—all with negative results. Again, he placed healthy animals in stalls where mad dogs had just previously been kept, so that the animals to be experimented upon were brought into frequent contact with the same straw, halters, chains, food, and wash-basins, that had been used by the diseased animals, but in no instance was hydrophobia produced; and the same may be said of placing animals in the stall with dogs which had recently died of this disease. According to the statement of this writer, healthy animals never manifest any aversion towards bread and meat that has been smeared with the mucus and saliva of rabid dogs.

Breschet obtained negative results in his attempts to produce hydrophobia by inoculating with small portions of the muscles, tendons, and the tissues of various organs taken from mad dogs; the same result followed inoculations made with blood, in which respect his experience was similar to that of Lessona and Renault.

In several instances in which guinea-pigs affected with hydrophobia were suckling their young, it was observed by Greve (loc. cit.; II., p. 38). that some of the young ones were infected by the bite of the mother; but in no case did they contract the disease through taking for some length of time the milk of their rabid mothers.

We thus see that the theory previously advanced in this article finds full confirmation in the results of these experiments, and leads to the conclusion that *the poison is only in very rare cases communicated in other ways than by the bite of a rabid animal;* such cases, for example, are those in which infection takes place by means of coitus or through intermediate vehicles, or by the consumption of meat or milk. In accordance with the opinions already expressed, I should be inclined to admit that the transfer of the poison by the agency of parasitic media is quite within the range of possibility.

Respecting the action of the *specific poison within the animal economy*, no adequate explanation has thus far been offered. In general, its action may be explained in two different ways: Either the virus remains awhile latent at the point of inoculation, and only after a certain interval—at the expiration of the period of incubation—enters and circulates with the blood and other fluids of the body; or else the poison, by undergoing incessant reproduction, is constantly supplied in fresh quantities to the blood. The aggregate amount of the poison introduced into the economy by the latter method is too slight, however, to give rise to any decided symptoms; or, possibly, the virus is by some physiological neutralizing process rendered innocuous and destroyed. In accordance with this view of the matter, we should be unable to attribute the long period of latency of the disease to the localization of the poison at the seat of inoculation. The latter hypothesis is supported, however, by the fact that dogs, which have been antecedently bitten by other rabid animals, are capable of communicating the disease by their bites even during the period of incubation; this view is also confirmed by the circumstance that an unquestionably beneficial effect is produced by the prompt local destruction of the tissues forming the *atrium* of the poison. This theory renders, moreover, quite intelligible, the favorable results (verified by several writers) which are obtained by the destruction—even after the lapse of some little time—of the local deposit, in which the process of incubation is taking place.

In what manner, or by what course the poison penetrates the body from the seat of the wound, is absolutely unknown.

The action of the poison has been compared by Virchow to that of a ferment, fresh particles of which are constantly being conveyed into the blood from the seat of the inoculation, producing through the medium of the circulation the specific effect upon the nervous system. The resemblance to alcoholic intoxication, and to certain forms of mental affections is unmistakable, the poison in each case producing its effects upon the centres of the medulla oblongata and cerebral hemispheres.

HYDROPHOBIA IN OTHER ANIMALS—GEOGRAPHICAL DISTRIBUTION.

Hydrophobia occurs in the fox, wolf, jackal, hyena, badger, and marten, as well as in the dog; also in horses, cattle, sheep, swine, goats, does, antelopes, guinea-pigs, and rabbits.

Although formerly the possibility of the communication of hydrophobia to herbivorous animals was generally doubted, it is now known, from the results of numerous experiments by inoculation, that the rabies of herbivorous animals also possesses infectious properties.

After similar experiments had already been made by various investigators, Bourrel (1847) inoculated a sheep successfully by means of matter taken from a rabid steer. Lessona (1852) inoculated two horses and a sheep from a rabid ox. Pillwax (1868) inoculated a dog with the blood of a rabid horse, taken from the body shortly after death.

In like manner are recorded positive inoculations from a man to a rabbit (Earle), and to a guinea-pig (referred to by Youatt). Inoculations with negative results were made by Adam (1858), who inoculated two rabbits with warm foam taken from a dog that had just previously died of hydrophobia; furthermore by Greve (loc. cit., I. 128), who introduced the virus into the native amphibia—serpents, lizards, frogs, toads, and salamanders.

With regard to the geographical distribution of the disease, it may be stated, in a word, in accordance with the views already expressed, that *no land or climate is free from hydrophobia.* The malady prevails just the same in countries where dogs live in perfect freedom—for instance in the East, in Algiers, China, Cochin-China, and the arctic regions—as in every part of Europe, where dogs, being domesticated, are deprived more or less of their freedom. In Europe hydrophobia is said to prevail most extensively in Germany, France, Holland, the north of Italy, and in England (Fleming).

On the other hand, as must appear evident, the greatest discretion should be exercised in crediting any report of the occurrence of hydrophobia in uncivilized and imperfectly known lands.

Virchow has stated, with a certain degree of reserve, it is true, that among the countries reported to be least frequently visited are Kamtschatka, Greenland, portions of Sweden and Denmark, the southern coast of the Mediterranean, the whole of Africa, and the southern portions of Asia and America. Boudin (1861) appears to confirm the view that hydrophobia, although of such frequent occurrence in Europe, is much more rare in the tropics and the polar region.

As opposed to these views, I will append a few more recent observations:

In February, 1860, hydrophobia broke out as an epizootic in Upernavik, the northernmost settlement of Greenland (72° north latitude). The thermometer stood then for some time at 25° F. below zero, and the favorable condition of the sledge roads contributed greatly to the spread of the disorder, which proved fatal to all dogs attacked.[1] In like manner, in 1863, hydrophobia prevailed in epizootic form in the northern portion of Greenland, completely destroying all the dogs in certain districts (Hamann).[2]

In Missouri and Ohio (United States) hydrophobia prevailed so extensively in the year 1860, that the cattle-owners solicited reimbursement from the government on account of their great loss in cattle.

In Constantinople,[3] hydrophobia rages in some years—*e.g.*, 1839—very widely; as a rule, however, according to one writer (Fauvel), it is rare, while according to another (Zoeros) it is not so unfrequent. It prevailed in Athens in epizootic form during the summer of 1866. The occurrence of hydrophobia in Crete and in Asia Minor has been recounted by Cælius Aurelianus. Notwithstanding a former report, it is now known for a certainty that hydrophobia occurs not unfrequently in Algiers (Guyon). Contrary to the assertions of Alpin and Larrey, who denied its existence in Egypt, the occurrence of this malady there has been verified by Pruner.[1]

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[1] *Hering*, Jahresbericht über Thierheilkunde, 1860, p. 55.

[2] *Leisering*, Jahresbericht über Thierheilkunde, 1866, p. 448.

[3] Froriep's Notizen, 1839, No. 188.

Hydrophobia is found, moreover, in the East Indies, in Java, British Guiana, the West Indies, etc.

Although the study of the geographical distribution of hydrophobia leads us to deny *in toto* the theory of its spontaneous origin, on the other hand we see that in many regions it remains unknown for a series of years, at length to burst out suddenly in epizootic form. That which is true of Greenland, where, when the sledge roads are in good condition, hydrophobia spreads most easily and rapidly, holds good generally for other countries. The frequency and rapidity of communication between individual countries is an important factor in determining the area of the geographical distribution of hydrophobia, and the parts of Europe above alluded to are the most frequently visited, because their intercourse is the most extensive, while at the same time they are the most thickly inhabited and contain the largest number of dogs.

We possess numerous observations by Franque, Köchlin, Oertl, and others,[2] concerning epizootics of hydrophobia among foxes. The malady prevailed toward the end of the last century in the vicinity of Frankfort, in 1803–1804 in the Pays-de-Vaud, in 1806 in Würtemberg (on the Lake of Constance), in 1819–1820 in Spessart, in 1823–1824 in the Taunus, in 1819–1828 in the eastern part of Switzerland, in the cantons of Zürich and Glarus, and from 1866 to 1872 in Carinthia.

By the prevalence of such maladies among those wild beasts of prey (fox and wolf), which are distinguished by their propensity to bite, their numbers become very materially diminished: in fact, they become almost decimated.

In respect to the *seasons*, no very decided preference is evinced by hydrophobia for any particular period of the year. It may rage at any time, but appears to be slightly more prevalent during the spring and summer months.

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[1] Compare the statements of *Virchow* (loc. cit., pp. 356 and 357).

[2] Compare the extensive statistics of *Schmidt* concerning hydrophobia of wild animals in his Zoological Clinique, B. I., p. 322. Berlin, 1872.

It is difficult either to prove or to deny the statement that in former times hydrophobia occurred less frequently than at present. According to the official mortuary statistics of London, no instance of the disease appears to have occurred between the years 1603 and 1728; subsequently to the latter date cases have been reported almost regularly.

In Hamburg hydrophobia raged as an epizootic from 1851 to 1856, about six hundred well-authenticated cases having been observed, although during the previous twenty-three years no instance of the disease had occurred. In Saxony, between the years 1853 and 1867, eight hundred and seven cases, genuine or suspected, were reported—a yearly average of about sixty[1] cases. In Bavaria, out of a total number of about 275,000 dogs, there averaged yearly during five years (1863–1867) eight hundred cases of hydrophobia, genuine and suspected, giving a proportion of 1:350.[2]

Symptomatology.

After a bite the wound generally heals very rapidly, inflammation ensuing in exceptional cases only. During the period of incubation, no specific changes are to be observed as the result of the hydrophobic infection, either at the seat of the wound or in any other portion of the bitten or infected animal.

The period of incubation lasts in the majority of cases from three to five weeks. Instances, in which this stage is of shorter (from six to eight days) or longer duration, are comparatively rare. According to Haubner the disease breaks out within two months in eighty-three per cent. of all cases, within three months in sixteen per cent., while in the remaining one per cent. it appears at the expiration of four months and later. The longest period of latency [in the dog—Tr.] is said to be eight months.

In the other domestic animals the period of incubation varies from two to five, seven, or ten weeks, and in exceptional cases may be extended to nine or fifteen months.

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[1] The original text reads "one hundred and sixty."—TRANSLATOR.

[2] The number of merely suspected dogs has undoubtedly been very considerable.

Hydrophobia appears in dogs in two different forms, which, in view of the experimental results, are to be regarded as two forms or varieties of the same malady. We recognize, therefore:

First. *The violent form of hydrophobia or rabies.*

Second. *The sullen form.*

There can scarcely be found any other disease respecting whose characteristics so many fallacious notions and reports universally prevail among medical men as well as among the general public, notwithstanding the fact that we have long been in possession of admirable accounts of the malady by Meynell, Youatt, and Hertwig. Before entering upon a description of the forms above mentioned, we may as well state at the outset that it is no easy task to trace an accurate description of a disease which presents so many varieties, depending upon the race, age, sex, temperament, and physical condition, so that, as is stated by Hertwig, two cases rarely correspond exactly.

THE VIOLENT FORM OF HYDROPHOBIA IN DOGS.

In the course of this variety of the affection three stages may be distinguished, viz.:

First. *A prodromic or melancholic stage.*

Second. *An irritative or maniacal stage.*

Third. *The paralytic stage.*

1. *The prodromic or melancholic stage.* Duration, from half a day to two or three days.

At the outset of the disease the animals manifest a changed behavior, becoming irascible, sullen, fidgety, and constantly changing position. In their conduct to those around them, they evince a variable disposition, being either more confiding and friendly than usual, or extremely irritable, morose, and easily enraged. The condition of hyperæsthesia is indicated by the fact that upon the slightest provocation they crouch, and are easily frightened. There is frequently observed a moderate redness of the eyes, and they will often lick their cicatrized wounds, thereby inflaming them afresh.

The animals manifest even at this stage a *disordered appetite,* and this feature, according to the most experienced observers, forms one of the most constant morbid symptoms. They reject all food, touching only a few favorite bits, or at other times the particles taken are dropped from the mouth. On the other hand, they will swallow all sorts of indigestible substances, such as are never devoured by healthy dogs—hair, straw, dung, rags, earth, bits of leather, and the like. They will eagerly lick cold objects, such as stones, iron, the noses of other dogs, and likewise their own urine.

The sexual instinct appears at times to be stimulated; the dogs will eagerly smell of and lick the genitals of other dogs. Meanwhile they manifest constant uneasiness, spring at the door, appear shy, and seem to be the subject of what is termed spectral illusions; they obey only with reluctance. Their movements already begin to show signs of uncertainty, and there is observed a weakness and tremulousness of the hind part of the body.

In this initiatory stage the outward appearance of the animals is not much changed. In consequence of wrinkles and folds being formed on the forehead and over the eyes, there is often exhibited a morose, ferocious look; the conjunctiva is generally strongly injected; the eye is frequently kept shut for several seconds; the pupil is moderately dilated. An increased discharge is poured out from the mucous membrane of the nose; a tendency to choke is not unfrequently noticed; also a difficulty in swallowing and a disposition to vomit. The seat of the bite, which is often sensitive, is frequently licked, scratched, and gnawed.

It often happens that the early symptoms are insignificant, nor are they uniformly present, and for this reason the greatest danger incurred by man is at this stage.

As some of the symptoms above described are frequently of very short duration, and are, moreover, met with in other diseases, they are therefore often of but slight diagnostic importance. At times the outburst of the disease is very sudden, in which case the early symptoms, supposed to be of a precursory nature, prove generally to have been active indications of its presence.

2. *The violent or maniacal stage; the period of actual rabies.* Duration, not longer than three, or, rarely, four days.

The characteristic symptoms appear only *spasmodically*, while in the intervals between the attacks they are present only to a slight degree. Among the most important of these symptoms may be enumerated a change in the entire demeanor, continued absence of all desire to take food, a very striking propensity to bite, a peculiar change in the tone of the bark, and the violent efforts made to break away and stray about.

At the onset of an attack there is noticed an increasing uneasiness, a frequent changing of position; house-dogs will fly at the door, while dogs that are fastened will struggle to break their chains, or, if shut up, will try to tear in pieces the sides of their kennel. In the latter case they will seize hold of the posts, bite into the woodwork of the sides, and roll about in the straw, which meanwhile they shake between the teeth.

When at large, the dogs wander about with no definite object, and often travel over a considerable extent of country within a short time (formerly termed running [laufende] rabies). Frequently the animals will return home, and are then suspicious and sly, or they will slink away, appearing very friendly, however, to persons with whom they are acquainted.

As has been correctly observed by Hertwig, the desertion of his home by a previously faithful dog indicates the existence of a high degree of mental disturbance. The propensity to stray off, especially after having been excited or corrected, is then often ascribed to fear, obstinacy, disobedience, or unsatisfied sexual desire, and the animal is all the more dangerous in this state if he quietly and peaceably return home.

During the paroxysms there is observed a decided propensity to bite, manifested to a less degree, however, in good-natured dogs than in ugly and ferocious animals. Many dogs snap and bite at whatever comes in their way; some eagerly attack other dogs, cats, birds, or larger animals, and more seldom men, who mostly escape with superficial wounds; they also frequently injure and tear their own bodies.

If a hard object, a cane, for instance, be presented to a chained dog, he will seize it spasmodically with the teeth, in a peculiar manner, and cling to it pertinaciously, often with such force that the teeth break and the lips bleed.

These rabid paroxysms, characterized by a strong disposition to bite, vary in their duration, often lasting several hours. The attacks may be excited by external means, for instance, by teasing, or they may come on without provocation, at the sight of other dogs or of cats. Frequently the animals give evidence of unusual strength, *e.g.*, by breaking loose from their chains, and by leaping over obstacles. During a paroxysm the animals are found, as in the case of mania, in a state of complete delirium; they evidently become the subject of hallucinations, snap at the air as if trying to catch flies, afterwards relapsing often into a sort of stupor. The expression of the countenance is then fixed and staring; frequently there is noticed a convulsive twitching of the face, while in the later stages there are occasional convulsions.

Sometimes the animals manifest a decided insensibility to external impressions, remaining perfectly quiet under blows and abuse, at which a sound dog would cry out lustily. They will even bite at a red-hot iron rod, and snap at the fire that is consuming their bed. In consequence of this impaired sensibility, the rabid dog has been known to bite off both testicles together with the prepuce, or the end of the tail, or they will gnaw away their feet even to the bone.

There is often observed a very decided *perversion of instinct;* rabid mothers, for instance, have been seen to bite their pups, or even to tear them with their teeth.

In the intervals the mental aberration either disappears entirely or becomes very greatly modified, and the animals then generally recognize their masters.

A closely related pathognomonic sign, that frequently makes its appearance in the first stage, is a peculiar *alteration in the tone of the voice.* When an attempt is made to bark, a peculiar sound, between a bark and a howl, is uttered in a rough, hoarse tone. This short, sharp sound is often prolonged into a howl. In emitting this characteristic noise, such as is heard in no other disease of dogs, the animals raise the muzzle somewhat in the air, just as healthy dogs do at the sound of music. The tone of the voice is seldom natural.

The food is, as a rule, rejected; occasionally the diseased animals will nibble a little of their favorite feed, but invariably only in small quantities. Instead of food, however, they will almost without exception devour large quantities of indigestible and offensive substances, such as hay, straw, hair, earth, and dung.

No special *dread of water* is manifested. In exceptional and extremely rare instances only do the animals suffer from spasms of the throat accompanying an attempt to drink (Adam). Moreover, rabid dogs will lick their own urine, splash about in water that is set before them, and drink freely thereof. They tolerate the sight of water without any signs of excitement, a fact that was demonstrated by Meynell, and subsequently by Blaine, Greve, Hertwig, and others. Equally unfounded is the notion that there is any aversion to light, air, or to the glare of the sun. In rare instances only is observed a slight sensibility to a bright light.

There is a very limited excretion of urine and fæces,—the fæcal discharge especially is reduced to a very small quantity, attributable to the circumstance that little or no nourishment is taken, for which reason an intestinal obstruction is hardly to be suspected. This condition may result, however, when the large intestine becomes distended like a sausage by masses of earth and sand; one very marked instance of which I have myself seen.

The *emaciation* of the animals, that rapidly supervenes, is attributable in part to the phenomena last mentioned, and in part to the excessive waste resulting from their continuous state of excitement. The entire appearance soon becomes unnatural, the eyes being sunken, the hair lifeless and rough, and the bodies thin. The mucous membrane of the mouth is but slightly moistened, and is often parched, and of a dirty livid color; a discharge of saliva and foam from the mouth is scarcely ever seen. Saliva is emitted only when there is inability to swallow.

The respiration, though at times hurried, is usually but slightly affected. On account of the great difficulty of controlling the animal, the pulse has been observed only in rare cases, when it was found to be slightly accelerated, and often irregular.

Among the ancient and unauthenticated traditions concerning the course of hydrophobia, may be mentioned the notion that there is always a discharge of saliva from the months of rabid dogs, and that the muzzle is covered with foam; further, that the tail is held closely to the hind legs, and that they always run in a straight line. All these symptoms are purely imaginary. As has been remarked above, the saliva is discharged only when there is inability to swallow. So long as there is sufficient strength, the tail is carried and wagged as usual; but with increasing weakness it droops; the course in running, as with healthy dogs, is sometimes straight forward, sometimes in diverse directions or in circles. Equally erroneous is the belief that a healthy dog can recognize one that is mad by a peculiar odor, and for this reason will avoid food that has been smeared with the secretions and excretions of the latter.

3. *The paralytic stage.*

This is developed directly from the previous stage, the paroxysms becoming weaker and less distinctly separated from the remissions.

Within a very short space of time the animals become completely changed in appearance by the sudden emaciation, which is all the more striking, when one considers the short duration of the disease. The hair becomes thoroughly roughened, the flanks fall in, the eyes appear dim, glistening and sunken; the lead-colored tongue projects from the mouth, which is generally open and dry. The countenance is staring and devoid of expression, the tail droops, and the whole appearance is appalling and repulsive.

The general weakness constantly increases, especially in the hind parts; the gait becomes uncertain and staggering; the animals are hardly able to stand, but tumble about like one intoxicated. Often they lie curled up, as if attempting to sleep, raising themselves on their fore-legs only when irritated; they still attempt to bite, or at least to snap, and are now only in a slight degree dangerous to those immediately about them. The voice becomes constantly hoarser, the breathing labored, the pupils dilated, the expression stupid and drowsy. The pulse is small and thread-like. At times partial or complete convulsions set in. Death ensues in most cases on the fifth or sixth day, very rarely later,—on the seventh or eighth day,—and life is never prolonged beyond the tenth day.

The *result* is invariably fatal. The cases of alleged recovery reported from time to time are not supported by trustworthy evidence.

THE SULLEN RABIES OF DOGS.

The *sullen* or *melancholic form of rabies*, which constitutes about fifteen or twenty per cent. of the total number of cases, is to be regarded, as has been intimated above, as a peculiar manifestation of the disease. While formerly the sullen was commonly supposed to be the first, and the rabid form, on the other hand, the second stage of the disease, it would appear more rational to consider that in the former the melancholic stage passes at once into the paralytic stage, according to which view the second or maniacal stage is to be regarded as omitted, or at the most barely noticeable. The disease runs therefore a shorter course. The *symptoms* of *irritation of the brain* are observable only in a slight degree; the animals are less lively and active, appearing silent, quiet, and depressed. Excitement, incessant motion, the propensity to stray away and to bite are less frequently noticeable.

Similar changes are manifested in the general disposition of the animals. There is but a slight inclination to gnaw and bite, and no great tendency to slip away. There is no aversion whatever evinced for fluids; the sexual passion is often aroused. *Paresis of the lower jaw* soon supervenes, in consequence of which the mouth remains partially or completely open, and it is only when greatly irritated that the power of shutting the jaws and biting is retained; a similar difficulty, though not always present, is experienced during an attempt to take food. There is great difficulty in swallowing, and almost everything that is taken into the mouth, however carefully, falls out again. In this form of the disease genuine frothing appears, resulting from the flow of mucus and saliva from the open mouth.

In addition, we may observe a variety of phenomena analogous to those of the violent form: the peculiarly changed voice, but seldom heard, the mental disturbance, the change in the appetite, the absence of fæcal discharges, the rapid emaciation, the paralysis of the hind parts, and the uniformly fatal termination, which results more quickly than in the violent variety, namely, within two or three days.

To review the general features presented by these two forms of the disease, we would note, *as the most important symptoms in violent hydrophobia*, the changed behavior, the peculiar uneasiness, the tendency to slip away, the propensity to bite, the perverted appetite, the absence of all desire to take food, the intermittent mental disturbance, the rabid paroxysms, the peculiarly changed voice—the howling bark—the altered appearance, the absence of any dread of water, the rapid emaciation, and the uniformly fatal termination after a brief illness.

In *the sullen form of hydrophobia* the general features of the first stage are similar to those just described ; paralysis of the lower jaw very soon appears, with the hoarse tone of voice, the disturbance of the mental faculties and appetite, and emaciation ; while the rapidly fatal termination is also preceded by symptoms similar to those of the violent form.

HYDROPHOBIA IN OTHER DOMESTIC AND WILD ANIMALS.

However interesting we might find a complete comparative description of hydrophobia, as it occurs in the different species and varieties of the zoological kingdom, we must content ourselves with an explanatory survey[1] of the chief symptoms to be noticed in the principal domestic and wild animals.

1. The *horse*, when attacked by hydrophobia, is at the outset greatly excited, and appears to be the subject of illusions. There speedily ensue indications of excessive fright, a tendency to bite, gnashing of the teeth, frequent neighing, great sexual excitement, and loss of appetite. When the specific paroxysms set in —and these are generally very severe—the animals begin to strike and kick, and manifest a strong propensity to bite. They will bite at the objects surrounding them, or that may be held before them, often wounding themselves and tearing portions of the flesh and integument of the fore-legs and flanks, or they will seize upon other animals. It is also observed that diseased

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[1] Drawn partly from *Röll.*

horses will rub the nose and mouth, making peculiar motions with both these organs. Respiration is generally greatly accelerated, and there soon follows a general aggravation of the symptoms—weakness, paralysis of the hind parts,—death generally resulting in from four to six days.

2. In *cattle* the symptoms are in part similar to those of the horse. When seized with hydrophobia, they bellow often and loud, in a hollow-sounding voice, show signs of mental derangement, stamp, and often butt so violently as to break off their horns. They seldom manifest a disposition to bite. Finally, paralysis ensues, and death takes place after a period varying from four to seven days.

3 and 4. In the *sheep* and *goat* the morbid symptoms are similar to those of cattle. The animals make unnatural leaps, butt eagerly, and soon become emaciated. At last paralysis and death are observed in from five to eight days.

5. *Swine* generally manifest fright at first; they are inclined to hide away, and become greatly excited by noises, wild, and exceedingly dangerous. During the paroxysms the disposition to bite is very great, and they tear first one ear and then the other. Meanwhile respiration is greatly accelerated. The visible mucous membranes assume a leaden hue, as does also the superficial integument; a viscid foam is discharged from the mouth; the eyes glisten. Death follows in from two to four days.

6. On account of the timidity of rabid *cats*, their symptoms are not easily observed. They manifest a great uneasiness, run about in an excited manner, and evince a strong propensity to bite. Death takes place in from two to four days.

7. The *domestic fowl*, when attacked with hydrophobia, is said to manifest great uneasiness, and to spring about wildly; a hoarse voice is noticeable, also a certain tendency to bite, and finally paralysis.

8. Of the *wild animals*[1] in which hydrophobia occurs, mention should be made, first of all, of the *wolf* and *fox*; then of the *badger*, *marten*, *jackal*, and *hyena*. In the wolf and fox, symp-

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[1] Compare the work (with catalogue of literature) of *M. Schmidt*, Zoologische Klinik, I., 2, p. 322. Berlin, 1872.

toms are manifested quite similar to those observed in the dog. They wander about incessantly, lose their fear of and aversion to man, manifest a strong propensity to bite, and attack with great boldness men, and the larger animals, especially dogs. In many instances they will make their way into villages and cities, and even into houses. Meanwhile all desire for food disappears; they have no dread of water. At last the animals become extremely emaciated and die. In many districts, where the malady rages in epizootic form, the foxes are actually decimated. The *badger*, *jackal*, and *hyena* behave similarly to the fox and wolf, though but few observations are to be found respecting the last two animals. Rabid *martens* are distinguished for their strong propensity to bite men, dogs, and other animals.

As in the case of rabies in the dog, there are, accordingly, to be observed in these different animals, as *characteristic symptoms of hydrophobia*, an altered demeanor, a peculiar restlessness, a changed voice, a loss of appetite, an absence of fæcal discharges, and finally a kind of paralytic weakness of the hind extremities, and death with convulsions. A constant disposition to bite is observable in those animals whose natural disposition is to bite. Rabid animals make use, moreover, of their special organs of attack and defence: horses kick, cattle and sheep butt. The disposition to swallow unnatural substances is observed only in the case of carnivorous animals. In none of the animals above mentioned is the dread of water found to be a symptom of rabies. They will lap water eagerly, or at least manifest no aversion to it so long as they are not prevented by the affections of the organs involved in the act of swallowing, which often supervene.

PATHOLOGICAL ANATOMY.

As is the case in some other serious affections of the nervous system (epilepsy, chorea), the results of the post-mortem examinations of rabid animals are of a decidedly negative character, and in part extremely variable, affording in this respect a marked contrast to the severe symptoms evinced during life.

Although post-mortem examinations, taken alone, furnish only in rare instances the data for forming an exact diagnosis, they are nevertheless of great value, and when considered inconnection with the clinical features of the case, will generally enable us to arive at a correct conclusion.

The morbid appearances are variable, an *absence of specific changes* being the only constant phenomenon encountered by the pathological anatomist as a slight reward for his labor. Apart from the unnatural *ingesta* found in the stomach and intestines, the appearances met with in the carcases after death bear the strongest resemblance to those seen in the case of certain forms of poisoning, for instance, in poisoning by strychnine, prussic acid, etc. As the result of my personal observations and experience, I should describe, in brief, the pathological changes found in rabid dogs as follows:

Upon *outward inspection*, the animals are generally found to be extremely emaciated; *rigor mortis* is noticeable in the usual degree; the hair is rough; the tissues about the nostrils and mouth are covered with dried mucus and dirt; the pupils are dilated; and the visible external mucous membranes (the conjunctiva and mucous membrane of the lips and prepuce) are covered with purulent mucus, and are of a dirty, livid color.

If the alæ of the nose be pressed together, there is discharged from the nostrils a foul-colored muco-purulent fluid. Upon the fore-legs are found, here and there, excoriated spots denuded of hair, and also superficial wounds. The cutaneous veins are distended with dark, thick blood.

Upon the removal of the calvaria, which contains an unusual quantity of blood, the *membranes* are found to be injected to a variable extent, while the longitudinal sinus is filled with dark-colored, thick blood; slight hemorrhages are rarely noticed here.

The *brain* itself is generally more or less œdematous, glistening brightly, and containing a variable quantity of blood. If the œdema be excessive, the convolutions are obliterated. The *medulla oblongata* and the spinal cord are often hyperæmic and œdematous, but more frequently exhibit no appreciable alterations.

The mucous lining of the *mouth* usually shows signs of catarrhal swelling, and is covered with a viscid, gray, dirty mucus, except upon the surface of the tongue, which is for the most part dry and of a dirty brown color. There may often be seen within the mouth fragments of foreign substances, such, for instance, as bits of straw, and at various points, especially upon the inner surface of the lips and the tip and edges of the tongue, numerous erosions and solutions of continuity. Vesicles and tubercles upon the under surface or at the base of the tongue are utterly wanting.

The *throat* frequently contains foreign substances, in the form of small collections of compressed hair or bits of straw. The mucous membrane, like that of the interior of the mouth and nose, is of a dark, dirty, brownish-red color, injected with blood, and usually covered with a dull-gray or grayish-white, muco-purulent liquid. The tonsils are either slightly swollen, or normal. The glands at the root of the tongue are, as a rule, likewise normal in appearance, but at times are moderately swollen and prominent. The submucous retro-pharyngeal and laryngeal connective tissue is generally filled with blood, while the lymphatic glands in this region are rendered dark by injected blood, hemorrhagic infiltrations being frequently noticeable.

The *salivary glands* are generally of a light grayish-red color, but are in other respects normal.

The *œsophagus* often contains a small collection of foreign substances. At the entrance of the canal the mucous membrane is frequently of a livid color and covered with a dull gray, viscous, mucous liquid.

The mucous membrane of the *larynx*, especially at the upper opening, is slightly reddened, injected, and lined with a grayish slimy deposit. In the trachea there is frequently found a thin mucous or purulent collection, often very abundant here, as also in the bronchi, which, moreover, contain here and there a few foreign substances.

The *lungs* seem on the whole normal, but are of a cyanotic color. There is poured out from the cut surface of the parenchyma, which contains air, and is both hyperæmic and œdematous, a considerable quantity of dark, tar-like blood. In some cases there are found lobular collections, which project somewhat above the cut surface, and discharge a sanguinolent, dark, purulent fluid, and which have been proved microscopically to be the products of *circumscribed pneumonia*, induced by the presence of foreign bodies (small vegetable particles and pavement epithelium).

The *large blood-vessels of the cavity of the thorax* contain a black, thick blood, in part loosely coagulated.

The *pericardium* and *heart* are generally normal: a few ecchymosed spots are seen here and there upon the inner surface of the pericardium. There is contained within the cavities dark-colored blood, in semi-liquid form, or loosely coagulated, mingled in rare cases with fibrinous coagula.

The *liver* is either of normal size or slightly enlarged, its tissue more or less hyperæmic and cyanotic. The blood that flows from a cut surface is likewise thickened and tar-like. The parenchyma is, moreover, succulent and glistening, and still shows upon the cut surface its natural markings, though at times these may be obscured. Under the microscope the cells of the liver appear cloudy, owing to the presence of fine granular matter.

The *spleen* is usually of normal size and consistence, and in rare instances only is slightly enlarged.[1]

The *kidneys* are usually of a livid and dark-grayish blue color, the capsules being readily separable from them. Upon section, the tissues are found to be rich in blood and friable, their natural outlines being well preserved. The inner zone of the cortical substance, as in the majority of the kidneys of dogs, is usually marked by turbid yellow stripes, while the microscope reveals the presence of fatty degeneration. The convoluted uriniferous tubules show microscopically a slight opacity of the epithelial lining, combined also in some cases with molecular disintegration.

The *bladder* is generally empty, or it may contain some turbid-yellow urine, which is often albuminous.

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[1] The spleen vesicles described by *J. H. Locher* (Dissert. inaug. exhibens magnum lienis in Hydrophobia momentum. Gött., 1822), which he likened to the exanthema of small-pox, are manifestly nothing more than lymphadenomata—grayish-white nodules of the size of a pea—which very often occur in dogs. So likewise, the hemorrhagic tumors of the spleen, described by *Prinz*, are simply accidental phenomena, which are also observed in perfectly healthy dogs.

The *genitals* are normal; though in the case of males there is frequently found a catarrhal inflammation of the mucous layer of the prepuce.

The *stomach* displays upon the outer surface an increased injection of the subserous venous trunks; the organ is usually firmly contracted, and contains no *remains of food;* but almost invariably there are seen *foreign bodies* and *indigestible substances*, most frequently hair and straw, in variable quantity, in sausage-shaped bundles; in many instances there are found large balls and rolls composed of hair, grass, straw, bits of leather, cloth, wood, and stones, mingled often with soft masses of dirt. The mucous lining of the organ is often of a brownish-red color, the apparent result of rapid imbibition; it is covered with a viscid and usually gall-colored liquid, and may exhibit the deep redness of vascular injection; it may also be the seat of hemorrhagic erosions.

The *intestinal canal* contains either a small quantity of pasty, gall-colored matter, which frequently emits an offensive odor (even in the small intestine), or foreign bodies, such as hair, wood, small stones, straw, earth, etc.

The *large intestine* is generally completely empty, but is at times distended with foreign bodies, in which case it forms a firm sausage-shaped mass, composed often, in larger dogs, of dark-grey and half-dried earth, mixed with small stones, weighing in all several pounds.

The lesions frequently found in the brain and medulla oblongata—the hyperæmia and œdema—are in all probability to be regarded as functional alterations, as are also the hyperæmic and hemorrhagic appearances observable in the mucous membranes of the throat and other organs of deglutition. The form of pneumonia produced by the presence of foreign bodies, which, possibly, is of frequent occurrence, though often overlooked, is to be referred, as in the case of mental disorders, to a disturbance of the mechanism of deglutition. One typical instance of this affection I have myself observed and reported at length.[1] In the case of rabid cattle, Franck[2] observed that the medicines administered very readily found their way into the lungs. This "foreign-body pneumonia" is also noticed in other affections of the central nervous system of dogs, in chronic hydrocephalus, for instance, on which account its significance, especially with regard to a differential diagnosis, is at most only a relative one.

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[1] Virchow's Archiv für path. Anat., Bd. 55, p. 285, 1872.

[2] Wochenschrift für Thierheilk. und Viehzucht, 1870, p. 340.

As to the attempt recently made by Rudnew[1] to refer the appearances found in rabid dogs to a parenchymatous inflammation of the kidneys, and to the uræmia produced thereby, I have already in another place (loc. cit.) demonstrated that the fatty infiltration and degeneration of the epithelium of the uriniferous tubules, as Rudnew designates it, is a physiological phenomenon, since the same lesion is met with in the majority of perfectly healthy dogs, as has been proved by numerous earlier writers, who were in the habit of observing the kidneys of dogs (Frerichs, Vulpian, and recently Parrot), and also by chemical analysis. Moreover, even if recent changes of this character (cloudy swelling, granular disintegration) occur here and there in the kidneys (and the prevalence of these phenomena is confirmed by recent investigations), they are manifestly, as in the case of hyperæmia and œdema of the brain, the results of the disease, induced either by prolonged hunger, or possibly by a lesion of the nerve centres situated in the medulla oblongata, and controlling the vessels of the kidneys. In an examination of the urine of a rabid dog, obtained after death, I was able to determine the presence of a moderate amount of albumen; under the microscope there were also found the elements of semen in considerable quantity.

Many observers describe changes similar to those of typhus, and to those found in anthrax, as occurring in rabid dogs; and also regard hydrophobia as a specific form of typhus fever. According to my experience, however, no disease prevails among dogs which can be designated by the term typhus, and the predisposition of these animals to malignant pustule is likewise extremely small.

On the other hand, it remains to be determined whether the absolute deprivation of all nourishment may not in a measure tend to promote the rapid course of the disease, and possibly contribute also to the production of certain symptoms, as phenomena similar to those seen in rabies have been often observed in starved dogs.

To sum up, then, the anatomical lesions described above, we find as the most important: *a dark, thick, and tar-like condition of the blood; œdema of the brain; more or less pronounced catarrhal alterations of the mucous membranes, especially of the respiratory and digestive canals, conjoined often with hyperæmia and ecchymoses; hyperæmia and cyanotic discoloration of the parenchymatous organs; an absence of the usual contents of the stomach and intestine, and the presence therein of indigestible foreign substances;* and, finally, *the striking emaciation of the entire animal.*

In wild animals which have died of hydrophobia, just as in cats, similar lesions are found upon post-mortem examination to those observed in dogs (Köchlin, Oertl, Bruckmüller). In herbivorous animals there is a complete absence of all characteristic changes. In cattle the morbid appearances are often similar to those of the cattle plague (Adam).

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[1] Centralblatt für die med. Wissenschaft, 1871, p. 321.

Diagnosis.

The diagnosis of hydrophobia in dogs is so difficult, and, on the other hand, of such decidedly practical interest, that we shall be justified in entering into a somewhat detailed consideration of this point.

In forming the diagnosis, we should have constantly before us a picture of the disease as a whole, and never base an opinion upon individual symptoms, such as the propensity to bite, which may be slight, or even entirely absent.

In general terms, it may be stated that in very many instances an accurate diagnosis cannot be made solely from the symptoms observable during life; nor, on the other hand, from the post-mortem appearances alone. With few exceptions, however, the diagnosis may be correctly established by a study of the clinical and anatomical appearances taken together.

Characteristic symptoms of the *violent* form of rabies are: the very great excitement, the marked uneasiness, the propensity to break away, the great disposition to bite, the peculiar bark or howl, the paroxysmal occurrence of the attacks, the rapid emaciation, the perverted appetite, the acute course, and the uniformly fatal termination of the affection. The *sullen* form of rabies, in which the violent stage is hardly recognizable, its course being extremely rapid, is characterized by the greater degree of tranquillity, the marked depression of the animals, the slight disposition to run away, the slight propensity to bite, and the partial inability to do so, in consequence of the paresis and paralysis which rapidly attack the lower jaw. The next most characteristic symptoms, common to both forms of rabies, are the peculiarly changed voice, the perversion of the appetite, the absence of all dread of water, the inevitably fatal termination after a very brief illness, and the uniformly infectious character of the malady.

In respect to the clinical diagnosis, great difficulties and frequent errors arise, from the circumstance that several other diseases of dogs are accompanied by analogous symptoms.

Symptoms resembling those of rabies are observed in *parasitic enteritis*, caused by tape-worms;[1] in *gastro-enteritis, produced by poison* (arsenic, corrosive sublimate, benzoic acid), or by the presence of *foreign bodies in the intestine* (bones and pieces of coin that have been swallowed); in *intestinal obstructions* (invagination), caused by the collection of *indigestible substances in the intestine* (fragments of bone); in the case of *foreign bodies in the ear* (heads of wheat, for instance, with the beard attached); in the case of *parasites in the nasal cavity* (pentastoma), in the *kidneys* (large palisade-worm), or *skin* (mange); in *uræmia*, induced by long-continued *unnatural alimentation* (starving,[2] feeding with substances containing no salt). In poisoning by means of *metallic preparations* (the salts of copper and zinc), there are likewise produced appearances similar to those of rabies:—constrictions of the pharynx, vomiting, and acute gastro-enteritis.

Symptoms similar to those of hydrophobia may furthermore be occasioned by *severe pain* (toothache), by severe *mental disturbance* (deprivation of their young, extreme stimulation and non-gratification of the sexual appetite); also by *various functional* and *anatomical changes of the central nervous system.*

In this connection should be mentioned numerous cases of meningitis, encephalitis, hydrocephalus, blood-poisoning (pyæmia, septicæmia); furthermore, the whole class of *mental diseases* in dogs, which have hitherto been completely overlooked, their existence not having even been suspected by most observers. The dog,[1] which as an intellectual and sensual being stands so high in the scale, and whose domesticated in-door life, as the companion of man, is in certain respects directly contrary to his nature as a wild animal, possesses a highly excitable nervous system, and is extremely liable to contract nervous diseases. This fact is shown by the frequent occurrence of the disorders falling under that head (for instance, epilepsy, chorea, epileptiform spasms, and spasms of reflex origin), and equally certain is the prevalence among dogs of pure psychoses, such as mania and melancholia, unaccompanied by any material post-mortem changes that can be detected; and these very forms of illness—having in part also a reflex origin through the causes above mentioned—are frequently confounded with hydrophobia, and quoted in support of the theory of the spontaneous origin of the disease, although they are in no respect infectious.

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[1] Tænia Echinococcus, for instance, which is often found in large numbers.

[2] In the case of herbivorous animals (stags, for instance), symptoms similar to those of hydrophobia may be produced by want of food. The animals then foam at the mouth, attack each other like dogs, tear out their own hair and flesh, and bite everything that they can seize hold of. This assemblage of symptoms was formerly mistaken for rabies, until eventually the true cause was ascertained, the disease being suddenly arrested by the administration of food. (Hering's Jahresbericht, 1856, p. 49.)

The fact that phenomena analogous to those of hydrophobia may be developed, as we have already seen, spontaneously, or in a reflex manner, has certainly tended in no small degree to encourage the denial of the existence of this specific malady.

It was known even to the ancients, that hydrophobia was confounded with other diseases, and in various authors the statement is found that a great number of dogs considered to be mad are not really so. This serves to explain the reports that are always being circulated, of alleged cures produced by this and that specific. Greve (loc. cit., I., p. 158), a good observer, admitted that out of twenty dogs supposed to be rabid, scarcely two or three are really so, and this admission appears to be not without foundation. According to Faber (loc. cit., p. 46), of 892 dogs which were brought into the veterinary institute at Vienna, suspected of being rabid, from 1826 to 1830, only 31 proved to be actually rabid and succumbed to the disease, while 61 were pronounced vicious and given to biting, and on that account were destroyed. Of 207 dogs pronounced (by medical men) rabid, or suspected of being rabid, in Würtemberg, in the years 1865 and 1866, 108—equivalent to 50 per cent.—proved to be rabid. The difference between a professional and unprofessional diagnosis seems pretty accurately expressed by these figures. As late even as the last century no fewer than seven varieties of hydrophobia were accepted by some writers

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[1] "The world moves by a dog's wit," is a proverb in the Zend-avesta, and while these words have a current value only amongst certain uncultivated people, or in certain lands, yet they forcibly express the high degree of mental development and capacity of the dog, with which few animals can compare.

(Hernauld), of which two passed as incurable and five as curable. The latter form manifestly had their origin in diagnostic errors.

It has been proposed to determine the diagnosis by *inoculation.* This process would be of very little practical utility, however, on account of the long period of incubation, and would be valuable, moreover, only in the case of positive results.

On the other hand, it not unfrequently happens that cases of hydrophobia, especially when appearing sporadically, or in the quiescent form, are not recognized. Cases of this character are frequently confounded with the distemper, an extremely prevalent disease among dogs.

What significance in a diagnostic point of view do the post-mortem appearances possess?

The difficulty of drawing definite conclusions from post-mortem appearances that have, on the whole, a negative character, renders it necessary, in order to arrive at an accurate anatomical diagnosis, to appeal to the symptoms observable during life. If these symptoms have not been noticed, as very often happens, or, in general, if there has been no previous clinical observation of the animal by a competent person, then, in accordance with the advice of Bruckmüller, in which I fully concur, it will be best *to pronounce every dog free from the disease, provided his stomach contain normal ingesta, and his small intestine contain chyme.* On the other hand, if the mucous membrane of the throat, larynx, and upper portion of the pharynx be hyperæmic; if the stomach contain indigestible foreign substances, and if the mucous membrane of the organ be spotted with hemorrhagic erosions, then the suspicion of hydrophobia will be strengthened.

A sure method of attaining greater accuracy in our diagnosis consists in *following up the clinical observation of the cases as thoroughly as possible*, in order to familiarize ourselves with the natural course of the disease, and in making a careful examination of the cadaver.

The following may be adduced, then, as *the principal data in determining the diagnosis* of hydrophobia: the *previous history of the animal;* the *symptoms manifested during life;*

the *acute* and *uniformly fatal course* and *termination*; and the *post-mortem appearances*.

Although it must be admitted that a dog already diseased may also become rabid, a diagnosis of hydrophobia will, nevertheless, under all circumstances, be extremely questionable, provided some other cause of death can be discovered (hydrocephalus, meningitis, pyæmia, apoplexy, etc.).

With regard to the frequent suspicions and charges—generally perfectly unfounded—to which veterinary surgeons are subject, when they express fears as to the existence of a case of hydrophobia, it may be remarked that, in view of the very weighty responsibility devolving upon medical men, a great many wrong diagnoses would be of insignificant importance, when compared with the serious results that might follow the failure to recognize a single case of genuine hydrophobia. That the physician, as guardian of the sanitary interests entrusted to his care, is entitled in this respect to be leniently judged, will be sufficiently evident when we consider that obstinate and unreasonable dog-owners understand very well how to procure the lax enforcement of police regulations designed to prevent the spread of hydrophobia; and that, furthermore, the exceedingly responsible duty of the veterinary surgeon is, as a rule, not a little onerous.

Prognosis.

Hydrophobia in dogs, as in all other animals, is inevitably fatal. There are no trustworthy instances of recovery upon record, the alleged successful results generally having their origin in diagnostic errors, by which hydrophobia was confounded with similar affections. The only favorable chance is that derived from an energetic local treatment of the bitten part.

Treatment.

Inasmuch as the prophylactic measures to be employed against hydrophobia will be taken up in detail when we proceed to the consideration of the disease in the human subject, I will only observe now, in passing, that the majority of the therapeutic agents embraced in the materia medica have been tried thus far to no purpose, being administered, in most cases, prophylactically after the infliction of the bite. Besides cantharides and cock-chafers, which for a long while enjoyed great repute, there have been tried, ineffectually, arsenic, prussic acid, tartar emetic, alternating with the sulphates of copper and zinc,- not to mention carbolic acid and chloral. The latter was administered in one case subcutaneously to a rabid dog by Horand and Peuch[1], without effect.

In cases where hydrophobia has broken out, every therapeutic application is attended with great difficulty and danger, and the only rational procedure left, therefore, consists in destroying the wound prophylactically by cauterization or excision, thereby inducing purulent inflammation. Meanwhile, however, it should be borne in mind that upon the hairy body of the dog small wounds and incisions are easily overlooked, and that the injuries inflicted by a rabid dog are often numerous.

HYDROPHOBIA IN MAN.

Rabies—Lyssa.

"Dogs are subject to hydrophobia, which makes them rabid; all animals bitten by them likewise become rabid, with the exception of man." If these words of Aristotle are not interpolated,—which is at all events a disputed point,—then, hydrophobia, as it occurs in the human subject, was unknown to Aristotle, and remained so down to the time of Celsus (about 200 B.C.). In the writings of the latter is found for the first time the word hydrophobia,[2] which is employed, however, to indicate a symptom of the disease, and for many reasons should have been abandoned. Celsus recommended as a prophylactic measure the application of a cupping-glass to the wound inflicted by a mad dog, and also cauterization by means of a hot iron.

At a later date we find mention made of hydrophobia, as it occurs in man, by Plutarch, Pliny, Dioscorides, Cælius Aurelianus (A.D. 300), and others. The last writer raised the question whether hydrophobia was an affection of the body or of the mind. With few exceptions (Aëtius, Paul of Ægina, Avicenna, and Actuarius), authors during many subsequent centuries only reproduced the writings of the ancients respecting this disease; but at length in the fifteenth and sixteenth centuries more trustworthy observations were made and reported.

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[1] Du Chloral, études cliniques et expérimentales. Paris, 1872.

[2] The expression hydrophobia has manifestly given rise to very great confusion, and the dread of water, erroneously ascribed to rabid animals, is without doubt due to the fact that a symptom of rabies peculiar to man was transferred, without reason, to animals.

In consequence of the totally incorrect ideas which prevailed in ancient times with regard to this most dreadful of all diseases, the fate of human beings who were seized with hydrophobia was indeed appalling. The nearest relatives fled from the unfortunate patients, abandoning them to their fate, as though they were caged wild animals. Every one feared to be bitten, and fancied that, by merely coming in contact with the body, or treading upon the saliva, of a diseased person, the malady might be contracted. And even in our day there are districts in Europe (the Military Frontier of Austria) in which the dread of hydrophobia—which, indeed, to the horror of the population and the despair of the surgeons, rages terribly—is so great, that human beings who are suffering from it, or who are suspected of being so affected, are shot by their neighbors, whilst those who have been bitten by rabid animals not unfrequently commit suicide.

Etiology.

Hydrophobia in the human subject appears in the form of an acute infectious disease, uniformly fatal, produced only by the implantation of a specific virus, the inoculation being brought about almost without exception by the bite of a rabid animal, most frequently that of the dog. An essential factor in the production of infection is a superficial wound of the skin, or of the external mucous membrane. Of the spontaneous development of hydrophobia in man there is just as little proof as in the case of animals. The disease may be transferred artificially back to animals; on the other hand, infection from man to man may be said practically never to occur. The period of incubation, as in the case of animals, is extremely variable.

By far the most frequent source of hydrophobia in man is the bite of a rabid dog (90 per cent.), while the other cases are communicated by cats (4 per cent.), wolves (4 per cent.), and foxes (2 per cent.).

Of 796 human beings who died of hydrophobia in France, Würtemberg, and Milan, 716 had been bitten by dogs, 30 by cats, 31 by wolves, 19 by foxes, and one by a cow. This proportion will, as a matter of course, vary according to local conditions; thus, in less cultivated lands (Russia, Galicia, the Military Frontier) rabid wolves prove a frequent cause of hydrophobia, whereas in the East Indies it is often produced by rabid jackals.

The situations of the bites upon the human body, the points of entrance of the specific virus, are divided as follows:[1]—Of 495 human beings attacked with hydrophobia, 263, equivalent to 53 per cent., had been bitten upon the upper extremities; 110, or 22 per cent., upon the head and face; 108, or 22 per cent., upon the feet, and 14, or 3 per cent., upon the body or scrotum. As we shall see hereafter, the wounds upon the face are the most dangerous; those upon the upper and lower extremities the least so. If a number of wounds be inflicted at the same time, the danger of infection is thereby increased. Large wounds are in general less dangerous than small ones,—a fact insisted upon by Dioscorides as much as eighteen centuries ago—because in case of the former the virus is more easily washed out by the flow of blood.

That this is not always the case, is proved by an observation made by Essroger, who reports that in December, 1863, 22 human beings were bitten by rabid wolves in Galicia; of these, eight, who had been severely wounded, died of rabies, and only one who had been slightly bitten. Moreover, it is to be remarked in this connection, that the prophylactic treatment of large wounds presents greater difficulties than that of small ones.

It is not necessary, however, for the production of infection, that an actual wound should be inflicted by the bite, for a simple scaling off of the epidermis is quite sufficient to permit the absorption of the virus.

A variety of well-authenticated observations tend to make it *extremely probable that dogs may, by their bite, produce hydrophobia in the human subject, even during the period of incuba-*

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[1] According to the statements and statistics of *Tardieu* and *Thamhayn*.

[2] Oesterr. Zeitschrift für prakt. Heilkunde, 1864, Nos. 3 and 8.

tion of the disease, as was shown at length when considering the etiology of rabies in the dog. Infection may therefore be produced by dogs that are apparently healthy, and for this reason, in practice it is advisable to pronounce every wound made by a stray dog suspicious, and to treat it accordingly.

Although dogs may produce infection by their bite even during the period of incubation, the danger of such an occurrence is, nevertheless, comparatively small, inasmuch as during that stage there is no disposition to bite. The theory, frequently advanced, that even the bite of a non-rabid but enraged animal may induce hydrophobia, may possibly be explained in this way, that the animals in question happened to be in the stage of incubation of rabies. In a similar way, dogs affected with the sullen form of rabies are less dangerous, because they are less inclined to bite, and, moreover, their ability to bite is very much impaired. The bite of rabid wolves is the most dangerous ; then follow those of dogs, foxes, cats, badgers, martens, and swine; and, finally, as the least dangerous, the bite of rabid herbivorous animals.

In some cases the contagion of hydrophobia is transmitted by an apparently healthy dog in the act of licking, when an open wound is licked. That the *unabraded epidermis* can in such cases permit the absorption of the virus, as has been pretended by many writers, is as yet hardly demonstrated, and is extremely improbable.

Communication of the specific poison by means of accidental wounds inflicted at the post-mortem examination of rabid dogs, has as yet in only one instance been satisfactorily proved.

On February 25th, 1857, a student of the veterinary school at Copenhagen, who had a small wound on the finger, made the autopsy of a dog, which had died the previous night of hydrophobia. In April he began to experience pain in the arm. On April 7th he complained of a feeling of *malaise* and fatigue, lay down, and was carried to the hospital, where, on the succeeding day, he died of hydrophobia.[1] Oppolzer[2] relates a case in which it was doubtful whether the individual in question was infected at the autopsy of a rabid dog, or by a bite. Autopsies of rabid dogs are said to have been frequently conducted without ill effect, at Alfort, by students having wounds, and although I am able to corroborate this evidence by my own personal experience, a certain amount of caution should, nevertheless, be insisted upon when the autopsy of a rabid animal is being made.

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[1] Tidskrift for Veterinairer, B. VII., p. 276, 1859.

[2] Wiener allg. med. Zeitung, 1863, p. 83, No. 11.

What proportion of the entire number of human beings that are bitten by rabid animals are infected?

The percentage of individuals who, having received a suspicious bite, become ill and die of hydrophobia, depends really upon the accuracy of the diagnosis of rabies as occurring in the dog, and whether we take into consideration only the bites of animals decidedly rabid, or whether we include the bites of animals suspected of being mad; and finally, whether a prophylactic treatment (cauterization) of the wound has been resorted to, and if so, within what length of time. If, bearing the above conditions in mind, an accurate computation be made, it will be found that of the human beings bitten by rabid dogs, about 47 per cent. die of hydrophobia. Out of 855 human beings thus bitten, 299 (or nearly one-half) cases ended fatally.[1] But if we include also the bites of dogs suspected of being rabid, then the proportion becomes decidedly more favorable, 8 per cent. only of those bitten becoming ill and dying. Out of 1,362 human beings that had been bitten by rabid dogs, and dogs suspected of being rabid, there occurred 105 fatal cases. If the wound is properly cauterized, the number of human beings attacked with hydrophobia amounts to 33 per cent. of the whole number bitten; where, on the other hand, cauterization is not resorted to, it amounts to 83 per cent.

The above explanation will enable us to reconcile the conflicting statements of different writers. Thus, Oppolzer admitted that, upon the average, one-half of those bitten were taken ill and died of hydrophobia, while Renault affirmed that the proportion was only 33 per cent., and Hunter declared it to be 5 per cent.

How great an influence is exerted upon the final result by *individual predisposition*, or by those factors which are accidentally brought into play at the time of the bite (clothing, deposit of the saliva upon the garments, the extent of the hemorrhage), it is difficult to determine.

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[1] According to statements and statistics of *Tardieu*, *Thamhayn*, and *Bouley*.

When several individuals are wounded by the same rabid dog, and one of them is attacked with hydrophobia, while the others remain unaffected, it does not necessarily follow that this is the result of individual predisposition; the immunity from infection may possibly be produced by one of the accidental factors above mentioned. This view is entirely in accord with the following experience, drawn, however, it must be admitted, from a moderate number of cases. Of those bitten in the face—this being an unprotected portion of the body—fatal hydrophobia results in 90 per cent.; in those bitten upon the hands, the proportion of those who sicken and die is 63 per cent.; in the case of numerous wounds upon the body, 63 per cent.; in wounds upon the lower extremities, 28 per cent.; upon the upper extremities, 20 per cent.

It appears to me, therefore, unreasonable to deny altogether the influence of predisposition in the human subject (Oppolzer), on the ground that there is no gradation of the power of resistance to the poison, as shown by the fact that neither milder nor severer forms of the disease occur, all cases running a similarly fatal course. This argument can hardly be maintained in the face of our knowledge of hydrophobia in the dog, and the results of experimental researches that are upon record (especially those of Hertwig), for in the case of dogs, also, there is no gradation of the resistance to the poison; no different grades in the disease have been known to occur, but all cases terminate fatally; and yet it has been proved beyond a doubt that there exists in dogs a very considerable resistance to, or affinity for, hydrophobia.

With respect to the *sex*, males compose 60 per cent. of the entire number of those attacked with hydrophobia, while females form 40 per cent.[1] Age exerts no appreciable influence upon the deaths from this disease, the youngest and oldest succumbing alike. In 195 fatal cases of hydrophobia, the ages of the patients were divided, according to Thomhayn, as follows:

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[1] Of 2,021 individuals dying from hydrophobia, 1,218 were men, and 803 were women.

12 between 3 and 5 years.
27 " 5 and 10 "
62 " 10 and 20 "
49 " 20 and 40 "
36 " 40 and 60 "
9 " 60 and over.

As to the influence exerted by the different *seasons* with respect to the prevalence of the malady in the human subject, this differs in no respect from that manifested in the dog, and the reader is therefore referred to what has already been said upon the subject. If hydrophobia in the human subject also prevails more extensively in the warm months, as appears to be the case, this may be attributable to the fact that the dogs are better able to rove about and come together at that time than in the cold season.

The *consumption* of the *meat* and *milk* of rabid animals (the dog, fox, ruminating animals, and swine), according to numerous observations, produces no injurious effects whatever upon man, a fact which harmonizes fully with the results of the numerous food experiments previously referred to, which Hertwig conducted upon dogs with uniformly negative results.

That the meat of animals dying from hydrophobia is not in itself injurious, but produces at most only a psychical effect upon those consuming it, is proved by the following experiment of Decroix.[1] He consumed a piece of roasted meat, taken from a dog which had died of hydrophobia, and afterwards he also ate a small piece (of the size of a nut) of the raw meat—six hours after the death of the animal. After having read, however, of the experiments undertaken by Gohier, in which a dog had become infected by devouring the meat of another rabid dog, while two other dogs had contracted the disease by devouring the meat of a rabid sheep, Decroix experienced a sensation of enlargement of the upper portion of the pharynx, difficulty in swallowing, weakness of the voice, disturbed sleep, and other symptoms, which, however, rapidly disappeared.

There are contained in the works of the older writers a few cases of *communication of hydrophobia from one human being to another*, the trustworthiness of which, however, is more than questionable. Such infections are said to have been produced, for instance, by sexual congress. Equally doubtful is it whether any reliable cases are known in which human beings suffering from hydrophobia have communicated the disease by their bite, although, in view of the successful attempts at retro-inoculation from men to animals, the possibility of that mode of infection cannot be denied. Attempts[1] of this sort have been made with positive results by Busnout, Berndt, Löffler, Magendie, and Breschet, while numerous similar experiments have resulted negatively (those of Pillwax, for instance).

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[1] Recueil de méd. vétér., 1864, p. 171.

There remain finally to be considered certain views concerning the nature and mode of origin of hydrophobia, as occurring in man, which differ essentially from those already referred to.

The hypothesis that the disease, when developed in the human subject, is simply an affection of the nerves, which may be induced by anxiety and excitement, brought on by apprehensions of the formidable malady, and that accordingly there is no specific virus of hydrophobia, is disproved by the fact that children under five years of age, and even under two years, whose imaginations surely cannot be affected by dread of hydrophobia, are likewise attacked by this disease.

Of three hundred and nineteen persons who died of hydrophobia in France, from 1850 to 1862, more than thirty, or nine per cent., were under five years of age. To the experiments of Decroix, above related, designed to illustrate the effect of eating the meat of rabid animals, should be appended a similar incident.[2] A number of persons who had partaken of the meat of a cow that had died of hydrophobia, were taken ill after being informed that the animal in question had been rabid. Their illness was confined, however, to vomiting, nausea, etc.

As for the old and periodically renewed theory,[3] which regards the existence of hydrophobia in man as simply a myth, the most that can be said in its defence is, that appearances analogous to those of hydrophobia may also, under certain conditions, be developed spontaneously, as purely mental affections, or as concomitant symptoms of hysteria, hypochondria, etc. In very many cases of this character it is difficult, and almost impossible, however, to exclude for a certainty the idea of an antecedent bite from a mad animal.

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[1] *Faber*, loc. cit., p. 284.

[2] Journal de Méd. vétér., 1854, T. X., p. 379.

[3] *Lorinser*, loc. cit.; *Maschka*, Prager vierteljahrschrift für wiss. Heilkunde, B. III., p. 1, 1871.

It has been affirmed by many more recent psychologists (L. Meyer,[1] Christian,[2] Westphal, and Skrzcecka),[3] that hydrophobia occurs as a symptom in various diseases. To this class belongs a peculiar variety of violent hydrophobia, a genuine disorder of the intellectual functions, a kind of hypochondriacal delirium, which often occurs in persons so predisposed, and is occasioned by fear of becoming mad—lyssophobia. Under certain circumstances, upon the accession of congestion of the brain, this may become fatal, and confers upon the disease a very strong resemblance to acute delirium. Cases of this kind are often erroneously designated as spontaneous hydrophobia, although they have no connection with the genuine *lyssa humana.* The question of the spontaneous origin of hydrophobia in man we will not include in the list of our subjects for discussion, having already denied emphatically, with regard to dogs, the idea of this mode of origin.

According to another view, hydrophobia in man represents a *simple neurosis*, a *traumatic tetanus* proceeding from the bite. Rose (loc. cit., p. 79) has adduced proof, supported by personal observations, that there exists no resemblance between a severe case of rabies and acute tetanus ; he describes in detail the diagnostic points of difference. "In traumatic tetanus a continuous spasm is present, to which there is finally added an increased reflex excitability ; consciousness remains clear until the death struggle ; the organs involved in the act of swallowing are generally unaffected ; the tetanic spasm begins in the masseter muscles and in those of the cervical region ; the disease is fatal only when it breaks out within a few weeks after the injury. In rabies, on the other hand, clonic convulsions occur ; reflex convulsions are noticeable from the outset ; loss of consciousness often ensues at an early stage ; the masseter muscles and those of the neck are not affected by the spasms ; the disease makes its appearance after a period of incubation lasting often for months ;

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[1] Virchow's Archiv, B. IX., p. 98.

[2] Gazette des Hôpitaux, 1869, No. 50.

[3] Archiv f. Psychiatrie u. Nervenkrankh., B. II., p. 520, 1870.

its course is uniformly acute; its termination fatal; its prominent feature consists of an affection of the organs involved in the process of deglutition." Rose further describes a rare form of tetanus, which in a more advanced stage presents a perfect picture of hydrophobia, the tetanus of the head, or *tetanus hydrophobicus*. This affection is a peculiar form of tetanus, in which the wound is invariably situated in the immediate vicinity of the cerebral nerves, and is frequently accompanied by convulsions of the muscles supplied by those nerves, especially the muscles of deglutition. These cases, according to Rose, have manifestly given rise to the notion of the identity of tetanus and hydrophobia.

PATHOLOGY.

Frequency of Hydrophobia in the Human Subject.

The frequency of hydrophobia in man depends upon the extent of its prevalence among animals.

The number of human lives sacrificed yearly to this disease may be appreciated from the following figures:

In Prussia there occur annually, taking an average of fifteen years (1820–1834), seventy-one deaths from rabies;—in Austria, average of eighteen years (1830–1847), fifty-eight deaths annually; in France, average of twelve years (1850–1862), from twenty-four to twenty-five cases annually; in Bavaria, average of four years (1864–1867), hydrophobia causes from seventeen to eighteen deaths annually.

Although the annual number of cases of hydrophobia in France is estimated by Boudin at two for every million of inhabitants, in Bavaria the annual number amounts to four in every million.

The question whether the rabies of dogs, like other animal diseases, may have been disseminated more extensively by the increased communication of men with each other, is worthy of a more thorough investigation, but cannot be accurately answered from the data now at hand. It is my own belief that the increased facilities for intercourse tend to facilitate the propagation of the disease, as I have already endeavored to show when treating of canine rabies. This circumstance is perhaps compensated for, however, by the improved sanitary police regulations for checking the disease, and the energetic administration of these measures. It is important in this connection, however, to consider in our estimate the variation in the number of dogs in a given locality, and similar factors.

Incubation.

The period of incubation of hydrophobia in man varies extremely in length. The duration of this period varies, in six per cent. of all cases, between three and eighteen days; in 60 per cent. between eighteen and sixty-four days, while in 34 per cent. this stage exceeds sixty days.[1]

While this period is seldom less than fourteen days, it is frequently protracted to from three to six months, and in extremely rare cases to two years and more. It is extremely improbable that this stage is ever extended to five and one-half, to seven (Schuh), or to from ten to twelve years (Chabert), and the latter statement especially should obviously be regarded as purely mythical.

In the young the period of incubation is, on the whole, shorter than in the old. In one hundred and sixty-six cases[2] of hydrophobia in the human subject, the period of incubation lasted, on the average, in individuals between the ages of three and twenty years, forty-four days; in those between the ages of twenty and seventy-two years, seventy-five days.

During the stage of incubation the persons bitten feel for the most part quite well, giving no evidence by any symptom that the germ of so appalling a disease lies dormant within them. According to Fuchs (loc. cit.), the wounds, being generally insignificant, heal kindly with or without treatment. Many observers have affirmed that these wounds are characterized by a striking absence of inflammatory reaction, on which account they are often kept open only with great difficulty. Even after the application of strong caustics, the wounds produced by the bites of rabid animals are said to manifest a strong tendency to skin over without granulating. The subsequent inflammatory reaction is generally slight, while the pain thereby produced is likewise for the most part moderate.

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[1] According to the statistics of *Hamilton* and *Thamhayn*.

[2] *Bouley*, Comptes rendus de l'acad., LXX., No. 14, 1870.

Touching the scar is said to produce peculiar sensations—a shuddering, feeling of anxiety, and sighing.

Symptomatology.

1. *Premonitory Stage, Prodromic Stage, Melancholic Stage.* After the expiration of the period of incubation in hydrophobia, a variety of precursory symptoms supervene, which, however, are often only in a slight degree characteristic, inasmuch as they may in like manner accompany other diseases.

The *wound* at the outset of the disease is generally cicatrized; the scar usually presents a normal appearance, and only in exceptional cases appears inflamed and swollen, and of a reddish or bluish hue. Tearing pains often proceed from the wounded parts, and they are frequently attributed by the patients to the effects of a cold, and to rheumatism thereby induced. Peculiar sensations are frequently experienced at the seat of the bite or in the adjacent parts;—either a sensation of prickling, or a boring, pricking, or burning feeling, always proceeding from the wound.

It is often asserted that there are *accidental causes* which hasten the outbreak of the disease, such as an outburst of passion, taking cold, or excesses of various kinds. Meanwhile, the majority of patients have no adequate conception of the real origin of their malady; not even when their attention is directed, by questions put to them, to the possibility of an infection with hydrophobia; they then affirm in decided terms that the scar is of no significance whatever, and that it causes them no pain.

In other cases the patients evince various symptoms of constitutional disturbance, complaining of a want of appetite and of headache; very soon they relapse into a state of depression and gloomy agitation; they are ill-natured, apprehensive, excitable, and are seized with a mental disquietude, by which they are driven incessantly about without any definite aim. This agitation often increases to an indescribable feeling of anxiety, especially when they know that they have been bitten. In the latter case, they endeavor to contend against this idea, and try to convince themselves and others that the bite cannot be the cause of their trouble; and in many instances they do not hesitate to deny with great obstinacy that they have ever been bitten.

Almost all patients, however, appreciate even in this stage the formidable character of the disease, and speak frequently, with a remarkably quick and sharp articulation, of the impending unfavorable result. They suffer now from insomnia, or else their sleep is extremely restless, and disturbed by fearful dreams.

A not uncommon, and pretty significant symptom is the *aversion to fluids*, and the great sensitiveness to every breath of air and reflection of light. In this stage, moreover, there is noticeable at times a trouble in the throat, a difficulty in speaking, spasmodic contractions upon the attempt to drink, slight difficulty in swallowing, and, together with the dread of fluids, an intense thirst. As indicative of the obstructed respiration, there may be heard a frequent sighing and sobbing; if the patient is lying in bed, there is often noticeable an unnatural contraction and tossing about of the limbs. Headache is complained of, sensations of convulsive action in different parts, distress at the epigastrium, heaviness of the limbs, and general prostration. The interior of the throat will often be found upon examination to be reddened.

If the mental anxiety is great, the pupils are, in some cases, dilated, while the face and conjunctivæ are injected. The pulse is usually slightly accelerated and hard, being more frequently small than full.

The appearances on the part of the digestive apparatus are extremely variable, and rather of an accidental character. In addition to the want of appetite and excessive thirst, there are sometimes observed vomiting and frequently constipation. There is no loss of consciousness; nor are the intellectual faculties in any way impaired.

It should be remarked that these appearances are more or less inconstant, and when the precursory symptoms are absent,—

when the disease breaks out of a sudden in all its severity—*then the inability to drink is the first symptom.*

To recapitulate the initiatory symptoms above described, it is noticeable that the local neuralgia generally has the peculiarity of shooting out from the bitten part towards the trunk, less frequently extending outward from the sensorium, or appearing in some locality other than the part injured. There are to be found, moreover, as precursory signs, in the majority of cases, uneasiness, anxiety, a changed disposition, gloomy forebodings, and a sensation of creeping and pain in the scar. As less characteristic symptoms, may be mentioned a feeling of prostration, insomnia, want of appetite, headache, and rarely a slight fever.

The duration of the prodromic stage is generally not more than twenty-four hours; very rarely, it is extended to two or three days, or even longer.

II. *Stage of Excitement—Hydrophobic Stage.*

It occasionally happens in the human subject, and often in the case of dogs, that the disease begins without being ushered in by any precursory signs. The patients are then suddenly seized with convulsions of a paroxysmal character, which are brought on by the attempt to drink water, by a sudden fright, or by any agitation.

The above described symptoms of oppression in the throat and difficulty in swallowing will, as a rule, be found to have preceded the severer phenomena; at other times the patients first complain of an oppression in breathing, before a pretty severe suffocative attack occurs, induced by spasmodic contractions of the respiratory muscles, combined usually with alarming spasmodic constrictions of the pharynx, and at this time surgical assistance is often for the first time summoned. Both forms of convulsions are pathognomonic, and there results therefrom the *dread of water*, the patient experiencing thirst and desiring to drink, but being prevented from doing so by the spasmodic constriction of the throat.

From this time on, all further attempts to drink are avoided, the patient preferring to endure the most intense thirst. The mere sight of a drinking vessel containing water is intolerable; the patient will turn away his face, shriek out loud, beckon anxiously with the hands to have the water removed, for voice and breath fail him. The mere thought of fluids, of drinking, or of swallowing, or the offer of anything to drink, is sufficient to bring on the convulsions, and the same effect is produced by other sources of irritation, such as a simple breath of air, the attempt to touch him, every hurried approach towards him, the sight of shining objects.

During these attacks the expression of the face indicates great anxiety and alarm; the muscles of the neck and breast, and frequently the entire muscular system, contract spasmodically; a convulsive trembling of the limbs is noticed, and in rare cases opisthotonos ensues.

Meanwhile the patient suffers from great distress in the precordial region, and dyspnœa; he has a disturbed look, is greatly excited, and is disposed to be extremely talkative. but is not delirious. As the malady progresses, these convulsive attacks are repeated, and are conjoined with an exalted state of the sense of smell, taste, and touch, and with a feeling of anxiety and a fear of being alone.

This excessive *hyperæsthesia* is manifestly the cause of the aerophobia, in consequence of which even a current of air, a bright light, the sight of any shining object, the slightest touch, and even conversation in the vicinity of the patient may throw him into a most violent agitation, and bring on severe convulsions.

In consequence of the *dyspnœa*, a sighing and groaning respiration is often to be heard, or there are emitted before and after, as well as during, the paroxysms, shrill, inarticulate sounds. The latter are either the expression of utmost despair, or they may be occasioned by violent expirations; they frequently give rise to the idea that the patient utters a sound like a bark, after the manner of dogs.

The local sensations of pain, experienced in the wound during the prodromic stage, still continue, often even in an increased degree, but are now scarcely heeded. As the disease progresses, the convulsive attacks increase constantly in severity, while the intervals, which afford rest at least for a brief space of time, become shorter and shorter.

The feeling of suffocation, and the hallucinations which often supervene, produce in the patient the most intense anxiety; and at times we may see this excitability and restlessness aggravated to such a pitch that the paroxysms appear like maniacal attacks accompanied by delirium. These attacks come on usually at the height of the disease, and the fury of the patient is then for the most part vented upon those about him. The surgeons and attendants are charged with having been the cause of his misfortune, and, when they approach him, are struck and insulted. Such attacks do not usually last long, and subsequently the patient will often evince great regret at his behavior, making earnest apology, and warning from time to time those about him not to allow him to bite them. At times, during the phrensical fits, snapping motions are made with the jaw, of an involuntary and spasmodic character, and bearing some resemblance to the motions of biting.

The general muscular contractions appear with variable degrees of intensity, from the slightest convulsions to those of the most severe and clonic form, while frequently tetanic convulsions are observed.

Although, during these convulsions, mental illusions and hallucinations often occur, in the intervals, consciousness and the mental faculties are for the most part retained. In addition to the symptoms above mentioned, it may be noticed that, during these tranquil intervals, the patient responds correctly to questions put to him, recognizing those around him, and, with a presentiment of impending death, begs them to pray for him, and not to leave him alone.

The saliva, which is now secreted in increased quantity, can no longer be swallowed, and salivation is therefore induced, the saliva being ejected by the patient in all directions.

It often happens that all the symptoms become quickly aggravated, and death takes place of a sudden, preceded by a striking amelioration in the condition of the patient, and at times even after the ability to drink has been restored. The fatal result may, on the other hand, occur in the midst of a paroxysm, through apoplexy or asphyxia.

Those cases are very exceptional, in which there can only be detected the symptoms of a simple affection of the throat, conjoined with a state of extreme excitement.

Analysis of the Different Symptoms.

It is evident that the most important of all the morbid symptoms evinced by man in cases of hydrophobia are, first, the peculiar *spasms of the muscles of deglutition and respiration*, which make their appearance especially when water is offered —*hydrophobia*—or are induced by a draught of air, or by the opening or closing of a door—*aerophobia.*

The *duration of the hydrophobic paroxysms* is variable; the spasms are generally short, and rarely continue longer than from one-half to three-quarters of an hour. They come on for the most part suddenly. There are observed during the attack, in addition to the symptoms already alluded to, muscular twitchings, a flow of saliva from the mouth, and a restless tossing about. The quiet intervals are likewise of variable length, at some times being very brief, and hardly observable, at others, prolonged to several hours.

The *intensity of the paroxysms* is materially influenced by the sex, age and individuality of the patient, and by the mode of treatment.

In the case of females, and also of children, the attacks run a milder course. The patients can be quieted in a remarkably short space of time, especially in the beginning, if a calm, friendly tone be used, while the exaltation is increased more and more if the conduct of those about them be agitated, or if force be resorted to.

In rare instances, the paroxysms are completely absent, as in the sullen form of rabies in dogs. In their place is then observed dyspnœa, and deep sighing upon the attempt to swallow; or, at other times, the patient complains merely of great anxiety and obstructed respiration, and it is only shortly before death that a few paroxysms set in.

The accidental causes of the paroxysms are: the attempt to drink, the sight of fluids, the hearing of noises—such, for instance, as are produced by pouring out fluids—or the mere idea of these things. There is experienced in consequence a feeling of extreme anxiety; and the paroxysms which rapidly ensue, combined with a feeling of suffocation, almost produce strangulation.

In exceptional cases, the patient is able to swallow fluids during the entire course of the disease, although the act is accompanied by pain. It often happens that he succeeds in drinking, after those who were around him have retired, or when the attempt to drink is made with closed eyes, and with the aid of a straw. Warm drinks, such as milk, soups, and also wine, are often more easily taken than water. In the greater number of cases, however, there exists an absolute impossibility to swallow anything; and whenever the attempt is made, the attacks of suffocation, and the spasms of the respiratory muscles, as well as of the muscles of the face, the neck, and the rest of the body, return, together with great mental disturbance.

In like manner there is an inability to take solid food, or else this is consumed with the greatest difficulty. Attempts to eat generally give rise to convulsions. There are exceptional cases, however, in which food can be swallowed without difficulty.

The *spasms* appearing during the paroxysms partake of the character of reflex spasms. Their proximate causes are attempts to swallow, speaking, coming in contact with another person, the sight or idea of fluids, a bright light, the sight of shining objects or of some strange person, a loud noise, and strong odors.

The spasms of the individual muscles, as well as of the muscular system in general, partake usually of a clonic character. There are rarely observed tetanic convulsions, and a decided tetanus or trismus has never been known to occur.

In the intervals between the attacks, the intellectual faculties and consciousness remain, as a rule, unimpaired. Those about the patient are recognized, and questions put to him are correctly answered. On the other hand, the tone of the voice is at this time very much suppressed; the patient is extremely apprehensive, or disturbed and talkative, suffering constantly from insomnia, except when narcotics are successful in producing sleep of shorter or longer duration.

It is not uncommon to meet with cases, in which there is an impairment of the intellectual faculties, together with delirium and hallucinations affecting the different organs of sense. Many patients fancy that they see objects, animals, and men that are not present; others believe that they are reduced to their present wretched condition by the instrumentality of those about them, or they imagine that they are being abused, and energetically defend themselves against attacks and insults, which in reality are but the products of their own fancy.

In this way it may happen that a patient will fancy that he is being blown at by several persons, some of whom are not present; another will complain bitterly that a fire has been lighted, and that the stove is smoking, although there is no fire whatever in the stove; a third will continually direct a window to be closed, which is not open.

The patient's range of ideas is often extremely limited, and if left to himself he will occupy himself continuously with the same things, bringing frequently forward the same ideas within a short space of time, and always in the same manner. His speech is labored, short, and pathetic.

The maniacal attacks, which are often observed, are in many instances attributable in part to the treatment of the patient (to attempts to fasten him with chains, for instance), at other times they are merely the expression and result of horrible anxiety, and great distress occasioned by the feeling of suffocation. In like manner, the attempts to bite, which are now and then made, are merely actions of despair.

The expression of the face is quite variable; the reddened countenance often exhibits the reflections of the utmost mental and physical misery, of most horrible agony. The eyes are wild, rolling, staring, and livid; or the entire complexion is pallid and cyanotic, and the expression stupid. The globes of the eyes are generally injected, the pupils dilated, and the retina in the highest degree sensible to impressions of light.

The *pulse*, which at the outset is usually full, moderately strong, and rarely accelerated, becomes gradually weaker and quicker, especially after the paroxysms (120–180 beats to the minute); it is frequently irregular, becoming variable in its rate, and this variation takes place, moreover, with great rapidity. As death approaches, the pulse becomes constantly more rapid and smaller, until at length it is thread-like, and finally can no longer be felt.

The *temperature of the body* is usually but slightly elevated, the thermometer indicating 100.4° Fahr. It seldom rises to 105° or 106° Fahr., and is, moreover, quite difficult to determine, on account of the great restlessness of the patient, and can rarely be made out with accuracy.

The skin is generally moist, and even covered with perspiration, but during the paroxysms the extremities are cool and livid.

Respiration is, as a rule, normal during the intervals, but during the paroxysms it is gasping, irregular, and usually quite rapid, being often accompanied by decided dyspnœa. These convulsive respirations, which during the paroxysm play so important a part, are similar to those produced by the sudden application of a cold-water bath, and are regularly accompanied by spasms in the muscles of the throat. These forms of convulsions may either come on together, or those affecting the respiratory apparatus may precede those of the throat.

A viscid, thick *discharge* from the mouth may always be observed a short time before death. On the other hand, when the disease is fully developed, a profuse discharge of saliva is almost constant. The salivary, as well as the lachrymal glands, evince an increased activity, and the copious secretion of saliva, which, in consequence of the disturbance in the mechanism of the throat, cannot be swallowed, is incessantly ejected, the quieter patients expectorating into vessels provided for the purpose, or upon an indicated spot, while by the more excited ones it is discharged upon all sides. The ejected saliva is frothy, slimy, and ropy. It seldom happens that froth is observed around the outside of the mouth.

The *thirst* is always very much increased, and the patient complains of burning pains in the throat. The *appetite* remains frequently unaffected; but, owing to the extreme solicitude of the patient, it is commonly suppressed. The tongue is usually moist and clean; frequently it is slightly coated, more seldom dry and thickly coated. Less constant symptoms are: convulsive eructations, nausea, vomiting of a foamy, mucous, dark-colored substance resembling coffee-grounds. *Constipation* is generally observed, and a dejection is only obtained after enemata or laxatives have been administered.

The *quantity of urine* secreted, in consequence of the small amount of fluids taken into the stomach, is very scanty. The urine never contains albumen, has a dark-colored, cloudy appearance, and frequently contains a pretty large amount of sugar, evidently the result of lesions in the medulla oblongata.

We see, therefore, that the *second stage of hydrophobia* is chiefly characterized by the spasmodic character and violence of the symptoms. Especially prominent are the severe spasms affecting the organs of respiration and deglutition, induced by different irritative causes, especially the attempt to swallow, the sight of fluids, and the hydrophobia thereby created. With these symptoms are usually associated general clonic convulsions, and less frequently tetanic convulsions,—all of *reflex origin*. Finally, an anxious expression is depicted upon the face, and there is distress in the præcordial region, together with a copious discharge from the mouth; the sensorium, however, commonly remains unaffected in the intervals, while the paroxysms often approach in intensity to maniacal fits.

The duration of this stage is generally from one and a half to three days, seldom as short as one day, or as long as four days.

III. *Stage of Paralysis—Stadium Paralyticum.*

The last stage of hydrophobia, as it occurs in the human subject, is often of such short duration as to suggest a doubt whether it really forms a distinct period in the progress of the malady.

The fatal termination may ensue very shortly after the accession of the severe hydrophobic paroxysms, in which case the death agony lasts at most from one-quarter to one-half of an hour; less frequently death may take place suddenly, and during one of the convulsions.

It usually happens that death is preceded by a stage of general paralysis, the most important features of which are an abatement of all the more distressing symptoms, a freer respiration, a diminution in the reflex excitability, less impediment to deglutition, a rapidly increasing debility and prostration.

The transition from the preceding stage is often quite gradual; the convulsions become feebler and cease entirely—possibly from lack of vital energy—or they may burst forth afresh in full strength, to terminate in a complete collapse.

In this period of complete tranquillity, during which twitchings of the muscles are often seen throughout the entire body, the pupils are usually contracted, or they may be of unequal size, the eye is fixed, and strabismus frequently appears. Priapism, accompanied by frequent seminal emissions, is more rarely observed.

The saliva is no longer ejected, but runs from the open mouth. The voice becomes harsh and weak, the breathing accelerated and rattling, the pulse very small, irregular and very rapid. The skin is covered with a clammy sweat.

The subjective condition of the patients can hardly be said to be improved, notwithstanding the remission of the severe symptoms and the apparent amelioration, the majority being oppressed with forebodings of impending death. Consciousness is not generally impaired until a short time before death.

Many patients are again enabled to drink large quantities of water without difficulty, and this was considered of old to be a certain sign of death. Death itself may take place amid convulsions or from asphyxia. It may also approach quietly, seldom with symptoms of coma or suffocation.

This last stage of hydrophobia is the shortest, and lasts, as a rule, only from two to eighteen hours.

Duration and Termination.

Rabies in men lasts, in the greater number of cases, from two to four days (in 82 per cent.); in rare instances, from twelve to twenty-four or forty-eight hours; while in still more exceptional cases it may be protracted to six days and over.

Of the total number of those dying from hydrophobia, 9 per cent. die upon the first day, 36 per cent. upon the second day, and 14 per cent. upon the third day; in other words, then, 59 per cent. die upon the three first days. The shortest limit of the disease is from twelve to sixteen hours. Instances in which death occurred two hours after the outburst of the disease must be classed, to say the least, among the greatest rarities.

The uniform termination of hydrophobia is death. As will appear later, when we come to the consideration of the prognosis, the cases reported to have terminated favorably will readily admit of a different explanation, the alleged cures being in all probability based upon diagnostic errors. Alleged recoveries, therefore, whether occurring spontaneously or brought about by means of artificial assistance, are, in the present state of our knowledge, to be designated as very questionable.

In concluding our description of the clinical characteristics of hydrophobia in man, it should be distinctly stated that the complicated phenomena of the malady are not to be attributed exclusively to the action of the specific virus. However certain it may be that the mental disturbance and the anxiety of the patients at the appearance of certain symptoms exert a great influence upon the severity of the phenomena,—admitting even the existence of a genuine lyssophobia,—yet it will not do to go in this respect too far, and we are therefore bound to characterize as erroneous the idea that hydrophobic children, who are unacquainted with the effects and result of the malady, may go through the disease without being attacked by convulsions or mania. It must be confessed, however, that in the case of children, and also of men who have no suspicion of the nature of their disease, the course of the malady is generally, though not invariably, milder. The influence exerted upon the symptoms by prolonged thirst and hunger, can hardly be determined with accuracy. Reasoning from analogy with other experiences, with respect to the phenomena induced in man and animals by long-continued thirst, it may be safely affirmed that this factor plays a by no means unimportant rôle.

PATHOLOGICAL ANATOMY.

The morbid changes found in the human subject in the case of hydrophobia, as in some other neuroses (epilepsy, tetanus, chorea), are of an unsatisfactory character.

The results of post-mortem examinations are, upon the whole, generally negative, the alterations being even less pronounced than in the case of animals;—a phenomenon which presents a strong contrast to the formidable symptoms observable during life. The anatomical picture bears the strongest resemblance to that obtained in cases of death from asphyxia or thirst.

The cadaver of those who have died of hydrophobia is usually found to be decidedly emaciated; the *rigor mortis* may be moderate or well-marked; cyanosis of the skin, and extensive post-mortem discolorations, are also present, and mortification speedily ensues.

It often happens that the fatal wound, or the cicatrix left by it, is hardly to be detected. The nerves in the immediate vicinity of the cicatrix are generally quite unaltered in appearance, though in some cases they look slightly reddened; and in still rarer instances, in several of the smaller nerve-filaments in the neighborhood, there is considerable induration,[1] which may extend for a short distance beyond the seat of the wound.

There is found in some cases an emphysematous swelling of the subcutaneous cellular tissue of the lower part of the neck, the result probably of the interstitial emphysema of the lungs produced by excessive dyspnœa. This swelling may extend along the upper portion of the breast, and into the mediastinum.

The *brain* and its membranes are, as a rule, hyperæmic, and often moderately œdematous. The sinuses and the peripheral veins are generally distended with dark-colored blood, only slightly coagulated. The pia mater appears injected, while the venous plexuses and the membranes of the spinal cord are likewise filled with blood. In rare cases there are found serous effusions in the opaque subarachnoid tissue and the lateral ventricles, and also an increased adherence of the membranes of the brain to the convolutions. The brain itself appears often enlarged, its convolutions flattened; its specific gravity is increased, while on the other hand, that of the medulla oblongata and spinal cord is diminished (Bastian [1]). The consistence of the brain substance is usually normal, and is seldom diminished. The gray substance is often strikingly rich in blood, the small blood-vessels and capillaries being distended, and in spots varicose.

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[1] *Eichhorn* (loc. cit., p. 36) discovered, in a case that came under his observation at the Augsburg Hospital, several small branches in the vicinity of the cicatrix perceptibly thickened (to 1 or 1½ millim. in diameter). These filaments diminished abruptly in diameter as they approached the main nerve, and at a short distance off were not to be distinguished from the nerve-branches running parallel to them.

The membranes of the spinal cord are more or less congested and œdematous. The spinal cord itself, like the brain, is rich in blood, as is also the medulla oblongata.

In the nerves of the brain, as a rule, no abnormity can be detected. In certain cases there is found an injection of particular nerves or ganglia, for instance of the recurrent nerves, or of one pneumogastric, or of some one of the cervical ganglia of the sympathetic. The latter are then said to be of a less firm consistence and enlarged.

An actual inflammation of the sheath of the pneumogastric, and also of the cervical nerves at their origin, is also occasionally found. It is hardly necessary to add, however, that individual observations of this sort possess no especial value until they have been confirmed by more complete investigations.

In the *digestive organs* the following changes are found: The mucous membrane of the pharynx and epiglottis is usually of a deep red color, and injected, though, on the other hand, it is often quite normal. The soft palate is frequently reddened and swollen. Virchow [2] found in one case hyperplasia and recent swelling of the tonsils and follicular glands of the tongue, and he expresses the belief that this may possibly correspond in part to the peculiar vesicles whose occurrence has been reported. In the case alluded to there were found flat, roundish swellings at the root of the tongue, in the middle of each one of which was seen the dilated opening of a pocket (crypt, follicle). The follicular enlargement, according to Virchow, is a phenomenon[1] quite commonly observed in hydrophobia; it involves also the pharyngeal follicles and the lymphatic glands in the neighborhood of the jaw. Similar swellings were found by Virchow upon the inner side of the epiglottis, and these, corresponding possibly to the more chronic course of the malady, were pretty firm, and were characterized by the abundance of lymph corpuscles found in the gland substance.

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[1] The Lancet, II., No. 3. 1866.

[2] Die krankhaften Geschwülste, II., p. 611, with engraving of hydrophobia angina, Fig. 188. Berlin, 1864–1865.

The vesicles described by Marochetti[2] (observed first in 1813, in the Ukraine), and which are scarcely worthy of mention, were found, as was pretended by this writer, in men and mammalia which had been bitten by rabid animals. They were said to be situated beneath the tongue, on both sides of the *frænum linguæ*, and consisted of from four to eight bluish-white papules and vesicles of the size of a hemp-seed, which increased in size, became purulent, and contained the virulent poison. Whether these phenomena were accidental concomitants, or whether their description was an intentional fraud, is hard to determine.

In the mucous membrane of the stomach and intestine there is generally found a decided injection of the blood-vessels, while upon the former are frequently seen hemorrhagic erosions. The cavity of the stomach is in most cases empty, or it may contain a dark, opaque substance, frequently resembling coffee-grounds. The intestinal canal is usually well distended by gas; in exceptional cases the mesenteric glands are somewhat swollen.

The *spleen* and *liver* are, as a rule, in a normal condition; their consistence is variable, as is also the quantity of blood contained in them. Fatty degeneration of the latter organ is often observed.

The *heart* is normal, being filled with thick or slightly coagulated blood. The *blood* in the other parts of the body is usually thick, tarry, black, and but slightly coagulated. The coloring matter shows a tendency to stain the tissues.

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[1] At the autopsy of a case of hydrophobia in the human subject made by me in Munich, the follicular glands, tonsils, and remaining parts of the throat were found to be perfectly normal.

[2] Observations sur l'Hydrophobie. St. Petersburg. 1821; and Theoretisch-praktische Abhandlung über die Wasserscheu. Wien, 1843.

The *lungs* are charged with blood, contain air, are frequently œdematous and studded with points of atelectasis and hemorrhagic infarctions, while numerous sanguineous suffusions are observable beneath the pleura. In the bronchi bloody froth is not unfrequently found. The trachea and larynx are hyperæmic and reddened. The bronchial glands are frequently gorged with blood, and enlarged. Upon the pleura is often seen a soap-like deposit, as in the case of cholera.

The *kidneys* are for the most part hyperæmic, the cortical substance being swollen, slightly opaque and cyanotic.

Klebs[1] found, in a recent case, at the post-mortem examination, an intense redness of the ulnar and axillary glands of the upper extremities, as well as of the jugular and inguinal glands, the tonsils, and likewise the lingual glands. Peyer's glands presented, as a result of the very great swelling and redness of the outer follicles, a peculiar wall-shaped appearance. Upon *microscopic examination*, there were found in all the swollen portions of the lymphatic system, and particularly in the submaxillary gland, a deposit of finely granular, strongly refractive corpuscles of a faint brownish color, closely packed together in clusters; at some points in the form of a long row, and at others branching out so as to form large star-shaped figures, following in general the course of the blood-vessels. These corpuscles, according to Klebs, may possibly prove to be the vehicles for the transfer of the specific infecting material, but this is an hypothesis which further investigations alone can render valid.

Diagnosis.

The diagnosis of hydrophobia in the human subject is not, as a general thing, difficult. Whoever has once viewed the striking clinical phenomena will be able, by the aid of the previous history of the patient, readily to make a diagnosis.

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[1] Sitzungsbericht des Vereines deutscher Aerzte in Prag. Aerztliches Corresp.-Blatt für Böhmen, 1871, 11.

With respect to the diagnosis, the most important symptoms to be mentioned are: the decided *phenomena* attributable to the lesions of the central nervous system (medulla oblongata), the *severe spasms of the muscles of respiration and deglutition*, the *increased reflex excitability*, and the *spasmodic character of the morbid symptoms.*

If the previous history of the patient is altogether wanting, or is imperfect, the affair may, in the initiatory stage, be confounded with other affections. Either hydrophobia may be mistaken for some other nervous affection, whose general course is analogous to it, or the latter may, under certain circumstances, be regarded as, and treated for, hydrophobia.

The latter case may now and then occur after the infliction of simple wounds by dogs. Several cases have already been related in which patients, in their fear and anxiety, evinced symptoms really similar to those of hydrophobia, without having been at all infected by specific virus, and fell into a peculiar, mentally diseased state termed lyssophobia (*hydrophobia imaginaria*). With appropriate treatment these cases invariably terminate favorably, and are then apt to be regarded as instances of recovery from hydrophobia.

From a large number of cases upon record, there may be cited here an instance observed by Stadthagen. A boy was followed about by the street rabble, who charged him with having hydrophobia, and he was so thoroughly frightened that in a few days he began to manifest symptoms similar to those of hydrophobia. Having been sent home to his parents in the country, he speedily became well. He returned to the city, however, when the same wanton charge against him was renewed, and the result was that he relapsed into his former apparently hydrophobic state.

There is frequently observed, moreover, in certain forms of hysteria and epilepsy, a peculiar affection of the organs of deglutition, in which symptoms are manifested strikingly analogous to those observed in genuine rabies (Marsars de Cazelles, L. Meyer).

The resemblance between rabies in men, and several varieties of tetanus, was claimed to lend support, apart from the diagnostic significance of their phenomena, to the theory that rabies is but a form of tetanus. The fallacy of this theory has already been exposed by Virchow (loc. cit., p. 379), who portrayed accurately the distinctive points between lyssa and tetanus. In our account of the etiology of hydrophobia in the human subject, the observations of Rose were cited, which serve to confirm the deductions of Virchow. It is indeed admitted by Rose, that there exists a hydrophobic tetanus, in which the wound is always situated in the immediate vicinity of the cerebral nerves, and in the course of which spasms occur in the muscles of the jaw and throat, thus affording a certain resemblance to genuine lyssa. The chief difference between tetanus traumaticus and lyssa consists in this, that the former breaks out in from three to ten days after the reception of the injury, whereas lyssa is developed in the greater number of cases in from four to seven weeks after the bite.

A symptomatic hydrophobia may be developed as a form of the dysphagia which accompanies different affections of the throat and brain, and is easily distinguished from genuine hydrophobia.

Finally, there occur cases of so-called spontaneous hydrophobia, which obviously should be included under the head of psychical affections, the term having its origin in diagnostic errors. To this class are to be referred the violent forms of hydrophobia, which, according to Dubois,[1] are nothing more than species of monomania resembling hydrophobia (monomanie hydrophobiaque), or peculiar forms of hypochondriacal delirium. This affection occurs in the case of individuals having a predisposition to imaginary diseases, is generally induced by fear of hydrophobia, and is therefore a lyssophobia. At the outset, it bears a strong resemblance to acute delirium, and, if congestion of the brain supervenes, may prove fatal.

In all these cases in which hydrophobia[2] occurs as a symptom of other diseases, an essential point of distinction between them and genuine lyssa is based upon the circumstance that in the former, although there indeed exists an impediment to the act of swallowing, there is, nevertheless, in the greater number of cases an absence of all reflex excitability; furthermore, in actual lyssa the paroxysms come on spontaneously, whether the patient be awake or asleep, and are induced by spasms of the muscles involved in respiration, as well as those of deglutition.

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[1] De l'hypochondrie et de l'hystérie. Paris, 1833, p. 232.

[2] Apart from the confusion created in our ideas respecting the symptomatology of hydrophobia in the dog, the existence of the opinions above described furnishes an additional reason for abandoning completely the term "hydrophobia."

On the other hand, if we are ignorant of the previous history of the patient, genuine cases of hydrophobia in man may be easily mistaken for acute mania, inasmuch as in the insane there is frequently developed a dread of water, and even salivation, characterized by a reckless ejection of the saliva.

Westphal observed a well authenticated case of rabies which bore the strongest resemblance to acute delirium. In like manner two cases are described by Maschka, in which during life symptoms were manifested similar to those of hydrophobia. The autopsy revealed the existence of softening of the spinal cord, and also an effusion of blood between the membranes of the brain, with acute hydrocephalus. In cases of rabies, therefore, occurring in man, as well as in dogs, errors of diagnosis may be corrected by a post-mortem examination.

Prognosis.

The prognosis of hydrophobia in the human subject is absolutely unfavorable.

The malady always terminates fatally. The cases of alleged recovery, which are constantly recurring in the literature of the disease, when subjected to an accurate critical analysis, are invariably found to admit of some other explanation. Either proof is wanting that the animals in question, by whom the bite was inflicted, were really rabid, or else the pretended instances of recovery from the disease were in reality cases of mental disorder simulating rabies. Although I by no means wish to deny the possibility of recovery from hydrophobia, I cannot but regard it as a significant fact that not a single case of recovery has been reported by any of the recent able observers. Although, then, the prognosis of rabies in man is involved in so little doubt, and is indeed of a nature to inspire no hope, something more favorable may, nevertheless, be said, upon the other hand, respecting the danger to be apprehended from a wound inflicted by the bite of a rabid animal.

I have already taken occasion to point out the rabid animals which are to be considered the most dangerous, and also the parts of the human body which form the seat of the most dangerous wounds.

According to the statistics collated by Bouley, wounds of the face are the most serious, for 90 per cent. of these are followed by hydrophobia terminating fatally; in wounds inflicted upon the hands the mortality amounts to 63 per cent., and a similar rate is observed where there are several wounds inflicted upon the body; in wounds upon the lower extremities only 28 per cent. are fatal; and finally upon the upper extremities 20 per cent.

How great importance as regards the prognosis is to be attached to a *prompt cauterization* and *prophylactic treatment* of the wound may be appreciated from the following facts:

Of 195 persons who died from hydrophobia in France between the years 1850 and 1862, the cautery was not employed in 111; 45 were cauterized late, and 39 insufficiently (Tardieu). Of 200 human beings bitten by rabid animals, 134 were cauterized; of these 92 (69 per cent.) remained healthy, while 42 (31 per cent.) died of lyssa. On the other hand, in the 66 wounds that were not cauterized the rate of mortality amounted to 84 per cent. (Bouley). *While therefore in those cases in which cauterization is resorted to, scarcely* 33 *per cent. of the human beings bitten by rabid animals fatl victims to the disease, in cases where this operation is not practised, exactly* 83 *per cent. of those bitten encounter certain death.*

Of 143 persons bitten by rabid dogs in France from 1858 to 1862, 63 (44 per cent.) escaped without infection, and among these were 35 who had been cauterized within the first hour subsequent to the infliction of the bite. In the department of Hautes-Alpes 16 persons and one ass were bitten in the year 1862 by the same rabid dog. The human beings were cauterized and remained unaffected. The ass was subjected to no treatment and became rabid.

Prophylaxis.

In view of the unfavorable prognosis in hydrophobia, and the complete inefficacy of all therapeutic agents when the disease is once established, it naturally follows that in all rational efforts to control the malady prophylactic measures must always form our chief weapons of offense.

Of chief importance in this connection are the *general prophylactic measures* to be enforced by the State against hydrophobia in animals, and we will therefore endeavor to indicate what sanitary regulations are best adapted to confine the spread of this malady within the narrowest possible limits.

The first important point to be insisted upon is *the reduction of the number of dogs.* The comparative danger to be apprehended from hydrophobia diminishes as the total number of dogs becomes reduced, and the most effective method of reducing the number of dogs consists in *laying the highest possible tax* upon them. This tax should be the same for all dogs, without regard to sex, and any remission of the same should be strictly limited to such dogs as are absolutely necessary for the performance of certain kinds of work.

The aggregate number of dogs is very large. In Central Europe there is found on the average one dog for every sixteen human beings. The total number of dogs in all Europe amounts to about twelve millions. Delafond estimated the number of dogs in France in 1846 at between three and four millions. In Bavaria, according to recent computations there are found 300,000 dogs to 4$\frac{8}{10}$ millions of human beings. The disproportion between the sexes is shown by the fact that while the male constitute 85 per cent. of the total number of dogs, there are found on the average but 15 per cent. females. It may be stated, furthermore, in favor of the taxation of dogs, of which about 80 per cent are kept as a matter of luxury, that these animals, from the fact that they form the vehicles for the communication of various parasites, and also serve as nests for the propagation of these parasites, exercise a deleterious influence upon the breeding of cattle.

The State should also provide for a general *registration* of all dogs. Every dog should be provided with some distinguishing mark; the unrestrained roaming about of dogs should be prevented; all stray dogs should be pursued by the police and destroyed.[1]

When cases of hydrophobia occur, directions should be issued to cause all dogs to be muzzled for a considerable length of time; they should either be led by means of a cord, or else kept penned up. The failure to notify the authorities of the existence of a case of hydrophobia should be made a punishable offense. The regulations just mentioned ought always to be made applicable to as large a district as possible.

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[1] Principien einer rationellen Hundeordnung. Amtl. Bericht über den II. internationalen Congress der Thierärzte zu Wien, 1865.

Rabid dogs should be destroyed, and likewise dogs which have been bitten by them, although no human being may have been bitten. If human beings have been bitten by rabid or suspected dogs, these should be destroyed, as soon as the existence of rabies in them has been determined.

Dogs suspected of being rabid, and also the dogs bitten by them, should be carefully confined at the owner's expense, and, in consideration of the long period of incubation, they should be kept secured for at least six months. The ordinary term of confinement from six weeks to three months is manifestly too short.

The obligatory muzzling of dogs at times when hydrophobia prevails as an epizootic has always in all localities been attended by favorable results. On the other hand, it is pretended by some, especially those who favor the theory of the spontaneous origin of hydrophobia, that the wearing of muzzles favors the development of the disease, an assertion which is unsupported by proof, and which is also completely refuted by what is known respecting the mode of origin of rabies and by various observations. In Berlin, dogs were required for a period of nine years to wear muzzles, during which time no instance of hydrophobia occurred. It is, moreover, fallaciously urged by the opponents of the muzzle, that in localities where dogs roam about in large numbers perfectly unrestrained, and subject to no inspection, hydrophobia is an unknown evil. In the description of the geographical distribution of hydrophobia, I have already demonstrated how unfounded this notion is, and have taken pains to show that in such localities (Constantinople, Egypt) hydrophopia *does* occur. It may be mentioned as a matter of curiosity, that the artificial blunting of the front teeth of all dogs has been recommended by some, as a prophylactic measure against the malady, and it has been even suggested that small flattened metallic caps be fastened by a screw to the corner-teeth, for the purpose of rendering the bite innocuous.

The excessive prevalence of hydrophobia in many years is mainly attributable to the absence of any sanitary organization charged with the supervision of veterinary matters: to the want of statutory or police regulations, or to their inefficient administration, simple points regarding which medical authorities are of one opinion. By appropriate and energetic sanitary measures the hydrophobia of dogs, like the greater number of infectious animal diseases, may be easily confined within a small area, even if the malady be not suppressed at the very outset. The hypothesis of the spontaneous development of hydrophobia forms a powerful obstacle to the enforcement of all sanitary measures of this sort, and furnishes here, as in other epizootics, a convenient loop-hole, which leads to endless mischief.

The only efficient means of eradicating the disease, in the case of wild animals (foxes, wolves), is to destroy them indiscriminately in the infected localities ; this step is also important for the reason that the prevalence of the malady amongst these animals forms a continuous source of danger to human beings and dogs.

All attempts as yet made to subject dogs to preventive treatment by means of internal remedies have proved ineffectual.

Finally, the circulation among dog-owners of popular information concerning the nature and most important symptoms of hydrophobia, as it occurs in dogs, is extremely desirable, and at the same time an opportunity will be thus afforded of correcting the numerous erroneous ideas which are prevalent with regard to this disease as it exists in man and animals.

Proceeding now to the consideration of the *special prophylactic measures* to be adopted in cases of hydrophobia in the human subject, we shall be met at the outset by the interrogation, What agents should be administered before the outbreak of the disease for the purpose of affording the greatest protection to those who have been bitten by rabid dogs?

The *prompt* and *thorough destruction of the virus* at its point of entrance into the economy, is the answer to this inquiry. For this purpose various methods, which produce with more or less certainty the desired result, have for centuries been resorted to. The object of all these prophylactic measures is to destroy the wound, and with it the adjacent tissue, or to alter the character of the same, so that the virus may be made innocuous. In this connection should be mentioned cauterization with the red-hot iron, with chemical agents (nitrate of silver, solution of chloride of antimony, sulphuric and nitric acids, caustic potash), by igniting gunpowder in the wound, or by washing out the same with corrosive fluids, and this treatment is frequently combined with the administration of internal prophylactic agents.

As an efficient and thorough procedure the method proposed and carefully tested by Brefeld is worthy of recommendation: After the wound has first been syringed out with warm water, it is to be gently and thoroughly bathed and cleansed by means of soap-suds and a sponge, or with a solution of potash (or what is still better, a solution of carbolic acid). The wound is next to be cauterized by means of caustic potash, and for several succeeding weeks (from four to six) a suppuration of the cauterized wound is to be kept up; a simple ointment like resin cerate being used as a dressing, or compresses saturated with a two-grain solution of potassa. Whenever cicatrization proceeds too rapidly, the cauterization by means of a strong solution of potassa, is to be repeated. At the same time some simple mixture should be prescribed internally to allay the anxiety of the patient.

In order to effect a prompt and direct extraction of the poison, the *application of suction to the wound* is advisable, either by the mouth of the sufferer, if the position of the wound permit, or by some other person, this constituting decidedly *one of the most efficient measures, and one that can always be applied upon the spot.* By the greater number of writers this simple procedure has been condemned on account of its alleged danger. Apart from the circumstance that the danger incurred by the bitten person is at all events not very much increased by sucking the wound, even if it has not been cauterized. it has been demonstrated also by the numerous and carefully conducted experiments of Hertwig, that the specific virus is completely innocuous to dogs when brought in contact with the unabraded mucous lining of the mouth and digestive canal. We can therefore conclude with a tolerable degree of certainty, that the mucous membrane of the human mouth is in like manner unaffected by the virus. The application of a dry cupping-glass, if the seat of the wound permit its use might prove, in small wounds, equally efficacious.

This method of sucking the wound was long since described by Celsus, and was practised among the ancients by a distinct class of persons termed "*billi.*" The same process, wrongfully regarded by many as the most frightful of all prophylactic measures, is at the present day resorted to in many portions of France, in Italy, Scotland, and the wilds of North America, where no instance of infection by this means has ever been observed.[1] In Lyons, during the first twenty years of the present century, certain women (Hundssäugerinnen) made it their business to apply suction to the wounds made by rabid dogs. Their compensation was fixed at ten francs for the first operation, and five for each succeeding one. Of thirty-eight persons bitten by rabid dogs, and subsequently subjected to this operation, not one was attacked with lyssa. Finally, individual cases are known in which the saliva of hydrophobic men, or an object smeared with such saliva, has come in contact with the mucous membrane of the mouth of human beings without causing any ill effects, so that the experimental experience of Hertwig with respect to dogs may be said to be equally valid in the case of human beings. The observations conflicting with the views above expressed, which seem to favor the theory that infection may take place by the act of kissing, are of ancient date and untrustworthy.

The *application of the actual cautery*, and burning the wound by means of gunpowder, are to be less strongly recommended ; the former mode of cauterization is indicated at most only in cases of small excoriations, or in simple open wounds. The chemical and corrosive caustic agents penetrate with greater certainty every nook and corner of the wound.

While *simple scarifications* are useless, having merely the effect of producing, by means of the knife, additional inoculations, the excision of the wound or cicatrix with subsequent cauterization is very efficacious. This method is continuously indicated during the entire period of incubation, and for several subsequent days or weeks, and may possibly be of advantage even during the premonitory stage of hydrophobia.

Amputation of the wounded part, of a finger for instance, where no additional injury has been inflicted, has been likewise resorted to. In cases of numerous wounds upon different parts of the body or of an extremity, the general corrosive sublimate bath, as recommended by Fuchs, may be of advantage. As to the efficacy of a permanent hot-water bath applied to the injured parts, as recommended by Eulenberg, with the object of decomposing the virus by the application of heat, or at least of diluting and extracting it, there are no observations on record with regard to this point. Where the above cannot be carried into effect, the application of sponges and compresses saturated with hot water is said to produce a similar result. On the other hand, hot Russian steam baths have been suggested as a preventive measure (Buisson). Bathing the wound with cold water, vinegar, or brandy, is said to operate unfavorably, warm salt water being better.

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[1] Compare statements of *Faber*, loc. cit., p. 268.

Although, in accordance with authentic observations—those, for instance, made by Blaine and Hertwig upon themselves,—a careful, free cauterization affords great protection against the outbreak of the malady, no sure and absolute immunity is obtained by any local, prophylactic treatment of this sort, not even when applied within a short time after the infliction of the bite, and with all necessary thoroughness. On this account the custom has always prevailed of exhibiting also internal remedies as preventive agents.

In addition to a long list of secret remedies, which assuredly do more harm than good, there is hardly a medicament in the whole pharmacopœia which has not been tested in cases of hydrophobia, either as a prophylactic or a therapeutic agent. The most commonly employed drugs were always cantharides, the *Meloë majalis*, belladonna in large doses (even to the affection of the eyesight), mercury (in the form of calomel or mercurial ointment, pushed to the salivating point), calomel combined with venesection; furthermore, prussic acid, tartar emetic, sulphates of copper and zinc, strychnine, chlorine, and a variety of vegetable remedies. Arsenic, formerly employed extensively in India, was recommended at a later date by Arendt,[2] and quite recently by Guisan and v. Schaller.[3] It has been resorted to in Lyons (1846) ineffectually.

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[1] *Faber*, p. 399.

[2] Mémoire sur un nouveau traitement de l'hydrophobie. Compt. rend., T. LV., p. 570, 1862.

[3] *Guisan* (De la Rage, etc., Bern, 1868), and *v. Schaller* (Die Wuthkrankheit, ihre Natur, etc., Freiburg, 1873) adopted the following treatment in a large number of cases. After the bite of a rabid dog there was administered internally, as a prophylactic agent, thrice daily, for a period of six or seven weeks, from one-twentieth to one-tenth of a grain (children, one-fortieth) of the arsenite of potash (or soda). The wound was

Thirdly, the *psychical treatment* of the patient after a suspicious bite is of great importance. On the part of the medical attendant, and those about the patient, the greatest care should be taken "to preserve a calm demeanor, to avoid all allusion to the previous injury, and to appear cheerful" (Romberg). The physician should impress upon the mind of the patient a conviction of the efficacy of his treatment (Virchow). Attention should furthermore be paid to physical and mental rest, to regular habits of life, to the abstinence from all kinds of excesses, and the avoidance of every excitement.

Therapeutical Treatment.

The majority of therapeutical agents which have been employed prophylactically, have been likewise resorted to when the malady was fully developed; all, however, without effect; and our allusion to these remedies, which merely possess a historical interest, will be therefore as brief as possible.

Among the *remedies taken from the vegetable kingdom* should be specially mentioned box, rue, sage, the *Anagallis arvensis*, belladonna, opium, morphine, to which have more recently been added atropine, curare, and quinine, the last three of which have also been employed subcutaneously.

Of *animal substances*, those already alluded to, cantharides and the *Meloë majatis*, have been frequently resorted to. The *mercuriats* formerly played an important part, and are still employed, even at the present day, as a general thing, externally, in the form of mercurial ointment.

Neither the warm bath, prescribed in the most ancient times, nor river-bathing (Celsus, von Helmont), is at the present day resorted to. Buisson, however, suggested in their place the

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dressed daily with Fowler's solution. Upon the full development of rabies the treatment was symptomatic, arsenite of potash or soda being administered in doses of from one-twentieth to one-tenth of a grain from three to six times daily. If the toxicological effects of these drugs was produced, the dose was diminished. Inasmuch as the cases observed and reported by Guisan and v. Schaller admit of a varied interpretation, so far as concerns the efficacy of the arsenic treatment, it is to be hoped that further experiments will be instituted with this agent.

employment of steam baths, in order to produce active diaphoresis.

Venesection—to the fainting point—serves, at times, to mitigate somewhat the force of the convulsions; and when combined with the mercurial treatment, is followed by temporary relief. Copious venesections, however, undoubtedly hasten the approach of general paralysis and the fatal result.

Here should be mentioned, too, the amputation of the wounded extremity, which has repeatedly been performed to no purpose.

Transfusion with warm water (Magendie, Gaspard, Mayer) has proved equally ineffectual. Magendie injected two pints of water into the veins, and quickly produced thereby a decidedly quieting effect, a reduction of the pulse from 150 to 86, and a return of the ability to drink. The patient died upon the ninth day. In a similar manner, Gaspard saw the dread of water disappear after the injection of water, but death quickly ensued at the expiration of fifty-four hours. The transfusion of blood might possibly be worthy of a trial.

The exhibition *of the mercurial preparations*—internally in the form of calomel, externally by means of the mercurial ointment—to the extent of ptyalism, notwithstanding its extensive employment, has never been of any efficacy; on the contrary, it has rather tended to aggravate the misery of the patients, inducing a more copious flow of saliva, while the manipulations involved in the inunctions, acting as a strong excitant, tend to induce a constant recurrence of the convulsive paroxysms.

The administration of *belladonna* has likewise proved unsuccessful. The application of the actual cautery to the skin upon both sides of the spinal column affords no alleviation, though the patient may experience hardly any pain from this severe operation. The same negative results follow the cauterization and excision of the wounds after the disease has once broken out. The amputation of the parts bitten (an arm or finger), has had indeed the effect of allaying the pains, but is a source of great excitement to the patient, without causing any mitigation in the severity of the paroxysms.

The subcutaneous injection of *daturine*, *curare*, *atropine*, *quinine*, and furthermore, the internal use of *arsenic*, *prussic* *acid*, and *carbolic acid*, are all in like manner attended by no appreciable results. The inhalation of pure oxygen is said to cause the disappearance of the convulsions, and also of the delirium, without arresting the fatal termination; the method of faradization is also said to produce a transitory amelioration, but no permanent benefit.

The *narcotics* are unquestionably of the greatest value in the symptomatic treatment of hydrophobia in the human subject.

While belladonna, even in large doses, has no especial effect in diminishing the reflex excitability, large doses of chloroform, opium, and morphia (opium to the extent of forty-six grains in twelve hours; morphia in half-grain doses) furnish the most efficient means of alleviating the sufferings of the patients. These agents frequently afford, even though for a short time, quiet sleep and a subjective relief, though the convulsive paroxysms are none the less severe.

Among all the narcotic agents, *chloroform* stands at the head in the treatment of hydrophobia. With the production of complete chloroform narcosis, the paroxysms cease, returning, however, with the disappearance of the narcosis. The great difficulty, however, in the use of chloroform lies in the fact that the patients struggle so against the inhalation of this agent, that its administration is often impossible. Wagner, who, as the result of his own experience, strongly recommends chloroform, availed himself, at the same time, of the state of narcosis to administer, by the aid of the œsophageal tube, an abundant supply of nutritious food. He succeeded in keeping a patient in the condition of chloroform narcosis for sixteen consecutive hours.

During the narcosis the attempt may also be made to introduce liquid nourishment *per rectum.*

Repeated clysters of *chloral* have thus far proved ineffectual; but it is to be hoped that further experiments will be made with this drug, in the form, perhaps, of clysters, combined with subcutaneous injections, with the object of producing euthanasia.

To summarize, in conclusion, what has already been stated (appending a few words respecting the psychical treatment of the sufferers), our knowledge of the therapeutics of hydrophobia may be expressed as follows:

The entire treatment must be symptomatic and palliative, and all the remedies hitherto employed, with the exception of the inhalation of chloroform and the administration of the preparations of opium, have proved of no especial benefit. In these attempts to mitigate as much as possible the severe symptoms and to produce euthanasia, the chief indications are:

The removal of every cause of excitement; the separation of the patient from everything calculated to disturb or render him anxious; the maintenance of the utmost quiet; the employment of a friendly tone of address (in place of coercive measures); and the endeavor to calm the sufferer by kind treatment. In order to maintain the strength, nutritious enemata, the introduction of the œsophageal tube during the narcosis produced by chloral or chloroform, and the administration of food by its aid, are indicated. To this may be added the subcutaneous injection of curare and morphia.

THE FOOT-AND-MOUTH DISEASE.

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THE FOOT-AND-MOUTH DISEASE IN ANIMALS.

THE *foot-and-mouth disease*, which has been known for centuries, is an acute infectious disorder, communicated invariably from one animal to another by contagion. It prevails chiefly among cattle, sheep, swine, and goats, less frequently among horses, and still less often among fowls, and dogs. *The affection is characterized by a moderate constitutional disturbance, with fever, by the formation of vesicles and ulcers upon the mucous membrane of the mouth* (*stomatitis aphthosa*), *upon the coronary border and in the cleft of the hoofs, combined frequently with a pustular exanthema upon the udder.*

The so-called miasmatic mode of development of this malady, though almost universally conceded, has in this disease, as well as in the animal diseases already treated of, not yet been proved. All observations tend to show that the foot-and-mouth disease is propagated only by contagion.

The *materies morbi*, the precise nature of which is as yet unknown, is fixed, and probably volatile also. It is contained principally in the products of the specific local affection, the contents of the vesicles, the secretion of the ulcers, the saliva, and the blood, and in all the secretions and excretions of the diseased animal, especially the fæces, urine, and milk. The specific virus is capable of reproducing itself only within the diseased organism, and comes therefore under the head of the *endogenous morbid poisons*, evincing a pretty strong tenacity to life. In infected stables its activity is preserved for many months. The infecting principle is, moreover, *transportable*, its transference being effected through the agency of human beings (articles of clothing), animals, manure, tools, and other objects of every description. Inoculation may be produced either directly by immediate contact, or indirectly by means of the fodder, the inhalation of infected air, or by walking over ground previously trodden by diseased animals. Young animals (sucking calves) are frequently infected through the milk.

No wound is necessary to enable the virus to penetrate the economy. It may fasten upon the unabraded epithelial lining of the mouth, or it may find its way into the organism through the inhaled air or the food. Once having obtained a foothold in a stable, the malady generally extends from one animal to another, those in the immediate proximity of the diseased animal being invariably first attacked.

Bender[1] discovered small parasites, spores, and also great numbers of micrococci in the matter deposited upon the ulcers and aphthæ, while in the milk no trace of any organism was detected when this fluid had not been rendered impure by the presence of scurf or lymph. In one case observed by me, there were found in the fibrino-purulent deposit upon the ulcers in the mouth, numerous micrococci and cylindrical bacteria, and also numerous spheroidal bacteria, collected in groups between the layers of the partially detached epithelium.

A very great *affinity* for the foot-and-mouth disease is evinced by the above-mentioned animals, especially cattle, sheep, and swine; the predisposition is less marked in goats, and least of all in the horse and other animals (dogs, fowls). In animals which have once acquired the disease, the susceptibility ceases for a considerable period, or at least becomes very slight. Repeated attacks of the malady in the same animal are upon the whole rare.

The *period of incubation* lasts usually from three to six days, less frequently from two to eight days.

Symptoms.

The disease is ushered in with moderate febrile symptoms, the animals appearing dull and stupefied. Soon a catarrhal inflammation of the mucous membrane of the mouth sets in. Feeding is thereby rendered difficult, and the salivary secretion is increased to such an extent that the animals constantly drivel. Upon the *mucous membrane of the mouth*, especially upon the inner surface of the upper lip, and the edge of the upper jaw, where no teeth are found, also upon the tip and edges of the tongue, and less frequently upon the other portions of the mucous lining of the mouth, there are found whitish-yellow, slightly turbid vesicles, at first transparent, but filled later with a puriform fluid. These vesicles burst in a day or two, leaving behind, after the dead epithelium has been cast off, erosions and shallow ulcers. The latter frequently become confluent, forming in this way still larger ulcers. These sore spots heal in from three to six days, the process rarely occupying a longer period, after which the animals begin to feed once more with accustomed appetite and without difficulty.

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[1] Zeitschrift für Parasitenkunde, B. I. Jena, 1869 and 1870.

The development of the morbid process within the mouth is at the same time accompanied by indications of increased sensitiveness, redness, and pain in the cleft and along the upper border of the hoofs; standing is rendered difficult, the animals move reluctantly and cautiously, are inclined to lie down a good deal, while their gait is constrained and labored. In the course of one or two days there will be found, as in the mucous membrane of the mouth, vesicles both large and small, filled with a yellowish, opaque fluid, which soon burst, discharge their contents and dry up, leaving in their places crusts. Beneath these crusts the epidermis is gradually re-formed, the sensation of pain disappears, and at the expiration of about fourteen days—reckoning from the beginning—the healing process is accomplished, provided no complications supervene.

Upon the *teats*, and generally in the vicinity of the orifices of the lacteal ducts, vesicles, pustules, and crusts often appear upon the reddened integument. The immediate neighborhood of the orifices of the lacteal ducts, and in many cases also the greater part of the superficial surface of the teats, is frequently transformed, by the process of milking and the continuous tearing away of the crusts, into one purulent and corrupt surface.

In exceptional cases there is noticed a vesicular eruption upon the muzzle, the mucous membrane of the nose, the conjunctiva of the eye, and also upon the mucous membrane of the vagina.

During the course of the malady, as above described, the temperature is moderately elevated, reaching 102° or even 104° Fahr., while the pulse is slightly accelerated. In consequence of the fever and the disinclination to feed, the animals lose flesh, the flow of milk is diminished, while its quality is at the same time materially altered.

If the case is severe, and its progress unfavorable, there ensues an inflammation of the soft tissues of the hoofs, with the formation of abscesses, with separation of the horny wall and frequently also an arthritis of the contiguous joints. As the animal lies down constantly, this tends to the formation of metastatic abscesses. It is not an unfrequent thing for an abortion to occur during the course of the disease. As one of the *sequelæ* of the disease, especially in animals not readily controlled, there occurs an inflammation of the feet, resulting from the great weight of the body, and accompanied by detachment of the outer wall of the hoof. In consequence of this the animals often become so much reduced that it is necessary to destroy them. Inflammation of the udder is another common after-effect of the disease.

The total quantity of milk given by cows suffering from foot-and-mouth disease is seldom diminished by more than one-half, provided the animals are well kept. The *alteration in the milk* secreted consists really in this, that it coagulates prematurely, and presents frequently a yellow, colostrum-like appearance. In the severer varieties of the disease, there is formed a mixture of whey and slimy coagula, and the milk, when boiled, curdles in stringy masses. In other cases the milk acquires an acid taste, and after standing for about twelve hours it deposits a thick, yellowish sediment, having a nauseating, rancid flavor. At the same time the milk sours quickly, and evinces a strong disposition to curdle. If the casein be artificially coagulated (by means of rennet) there is then formed a slimy, pasty mass (Bircher). Lavena found that milk of this sort contained more water and salts than usual, but that it was free from mucus and pus corpuscles. Raikem states, that upon microscopic examination he saw pus corpuscles upon the bottom of the vessel; according to the statements of this writer, and also of Lombard, the milk gave an acid reaction. Donné and Turpin found the milk in this affection to be less homogeneous, and of rather a semifluid character; it did not coagulate upon the addition of acetic acid, but was made stringy by ammonia, and contained colostrum-like cells as well as mucous corpuscles. Herberger found in the milk of cows affected with foot-and-mouth disease, during the first stage, an increased quantity of alkalies, while the fat globules had a less distinct contour and were more run together than usual; the milk coagulated but imperfectly upon the addition of rennet. In the second stage it contained only a few fat globules, was slimy, viscid, and of a foul odor and taste, and coagulated likewise imperfectly upon the addition of rennet. In both stages the milk contained but little casein and sugar, but, on the other hand, a large amount of salts, among which was some carbonate of ammonia.

It is possible that the milk, as one of the secretions of the diseased body, contains within it the specific poison; aside from this, however, it is almost invariably mixed with the specific discharge from the wounds upon the affected teats.

The *course* of the disease is, as a rule, a mild one. Complications with other infectious diseases, especially anthrax, which is frequently believed to supervene in the severer forms of the malady, have not as yet been satisfactorily proved, and are besides altogether improbable.

The *duration* of the whole process is from twelve to fourteen days, seldom less.

The *disease terminates*, in the greater number of cases, in recovery. It is only young animals, less frequently grazing animals, under unfavorable conditions, and finally, those who have already some other illness (tuberculosis, myocarditis), which now and then succumb, or have to be destroyed. Yet many attacks of the disease are remarkable for their malignant character.

In sheep and goats the disease runs a similar course, attacking especially the feet, the vesicular eruption being, however, less pronounced. In swine, likewise, the feet form the principal seat of the eruption. In horses the disease appears but rarely, and then in the form of a moderate aphthous stomatitis. In beasts of chase (does, stags, and wild boars) the course of the disease is similar to that in tame animals. Fowls are often attacked, but carnivorous animals, on the other hand (dogs and cats), are seldom affected.

Foot-and-mouth disease spreads by following the lines of communication, and is carried along the different highways, particularly by driven cattle, moving with increased rapidity along the track of railroads. The following statements will convey an idea of the frequency and extensive prevalence of the malady. In the year 1871, according to the official reports, 700,000 animals were attacked by foot-and-mouth disease in England, and the same number in France. In the year 1869, the greater portion of Europe was visited by this malady; and, according to authentic estimates, were not the spread of the disease in a measure restricted by police regulations in most countries of Europe, at least one-quarter part of all susceptible animals would be annually attacked.

PATHOLOGICAL ANATOMY.

When a post-mortem examination is made of those animals which have been destroyed on account of severe and threatening symptoms, the following changes are observed:

Upon the inner surface of *the lips;* upon the gums and the toothless edge of the upper jaw, there are found, to a greater or less extent, ulcers with depressed, whitish edges, with a finely granular, rose-red or pale yellowish-red base, thinly covered with a grayish-white secretion. Other spots in the vicinity are covered with a scaly epithelial layer in process of desquamation; or, it may be, one portion of this layer is already thrown off, the eroded points being still loosely covered by the corresponding subjacent epithelial layer. It is in rare cases only that vesicles of varied size are found upon the muzzle. The ulcers and erosions, in which a healing process has been established, exhibit much less prominent edges, and a smooth, pale, or pale-yellowish base. Precisely similar changes are found within *the mouth*, upon the tip and edges of the tongue, and upon its surface as far as the median line, which often forms the seat of superficial ulcers as large as a silver half-dollar.

The lower half of *the teats* is often covered with pretty thick, brownish, yellow crusts, which frequently cover the greater portion of the udder, or else appear in the form of papules, varying in size from a pin's head to a pea, and adhering firmly and closely to the surface. The tissues immediately around the orifice of the teat are generally transformed into a small superficial ulcer. It often happens that single teats are covered throughout their entire extent by the above-described brownish-yellow, or dark-brown crusts.

Upon the *hoofs*, and chiefly in the cleft, both in front and behind, are likewise seated superficial ulcers, which are accompanied by induration and swelling of the adjacent subcutaneous tissue and fleshy portions of the hoofs.

In the *paunch* are frequently found, especially upon the rugæ, numerous erosions, with desquamation of the epithelium, —changes which are precisely analogous to those found in the mucous membrane of the mouth; vesicular formations are also frequently observed.

The *liver* is generally gorged with blood, and slightly enlarged, being in the condition of what is termed cloudy swelling with parenchymatous inflammation. In one case, the course of which had been very severe, I detected acute disintegration of the hepatic cells, so pronounced as to induce a general icterus. The morbid changes in the *kidneys* are quite similar to those in the liver. The *spleen* is normal.

In the *respiratory apparatus* is found a moderate injection of the mucous membrane of the trachea and bronchi. The lung-tissue is hyperæmic.

The *heart* presents no alterations.

In sucking calves, which become ill and die in consequence of having consumed the milk, there are found the changes peculiar to gastro-enteritis, and also regular aphthæ and erosions in the stomach and intestinal canal.

Diagnosis, Prognosis, and Treatment.

The *diagnosis* of foot-and-mouth disease presents hardly any difficulties.

The *prognosis* is, as a general thing, favorable; the almost invariable termination is in recovery; and only in exceptional cases, in which the animals are affected with some chronic disorder, does death ensue. To calves, the consumption of the milk of the diseased cow is dangerous in the highest degree; it frequently happens that from fifty to seventy-five per cent. of these animals die, chiefly in consequence of gastro-enteritis.

The best treatment for animals suffering from this malady is shown by experience to be a purely symptomatic one. They should be kept quiet in the stall, care should be taken to provide them with a supply of pure air, a moderate temperature, plenty of soft straw, frequent opportunities to drink, and sufficient soft aliment,—milk, meal and water, boiled grain, mash, bran, etc. The feet and hoofs should be bathed with warm water.

Any additional treatment, particularly if it involve any active medication, is quite superfluous, and in the majority of cases positively injurious. Compulsory inoculations should be resorted to in order to stamp out the disorder, a procedure which is generally attended by favorable results.

FOOT-AND-MOUTH DISEASE IN THE HUMAN SUBJECT.

Etiology.

The fact, formerly disputed by many, that there occurs in the human subject a morbid process identical with the foot-and-mouth disease of animals, is now established beyond question by numerous observations.

The affection is generally communicated to man in one of two ways:—either by the *consumption of unboiled milk*, obtained from a diseased cow, the most frequent mode, or else by the *direct inoculation of a wound*, especially upon the hand and fingers, produced either by milking cows having a vesicular eruption upon the udders, or by coming in contact with the saliva of infected animals.

Sagar (loc. cit.) was the first (1764) to observe, in Moravia, that human beings, who had drunk the milk of cows suffering from foot-and-mouth disease, experienced a difficulty in swallowing, a sensation of increased heat in the mouth and throat, and subsequently were affected with aphthæ in the mouth. At a later date (1820) Brosche (loc. cit.) reported an instance in which two young girls, who had a good deal to do with diseased cows, exhibited an exanthema similar to that upon the cows, consisting of an eruption of vesicles, filled with a transparent fluid, upon the swollen fingers and toes. A further observation [1] was made in 1827 in Bohemia, where, at a time when foot-and-mouth disease was prevailing very extensively among the cattle, young people were attacked with an inflammatory rheumatic fever, accompanied by an aphthous eruption in the mouth, or an exanthema resembling that of small-pox, and also by abscesses and ulcers upon the lower extremities.

The first to demonstrate experimentally the communicability of the disease was Hertwig, whose positive results were confirmed by Jacob.

During an epizootic of foot-and-mouth disease, Hertwig and two other medical men drank, each, daily, for four days, a quart of fresh milk taken from diseased cows. Before two days had elapsed, H. began to experience slight fever, twitchings in the limbs, headache, a sensation of dryness and heat in the mouth, and an itching in the hands and fingers. These symptoms, by no means severe, continued for about five days. Then the entire mucous membrane of the mouth began to swell considerably, especially that of the tongue, upon which organ, particularly the edges of it, and also upon the inner surface of the cheeks and lips, there appeared small vesicles, never larger than a lentil, of a yellowish-white color, and filled with turbid whitish contents, which were readily discharged when the vesicles were pricked, but were soon reproduced. Upon the following days, these vesicles became still larger, and burst; the epithelium was then detached, leaving behind dark-red erosions which gradually healed. There was conjoined with the above symptoms a smarting pain in the mouth upon the attempt to masticate, speak, or swallow, and also an intense thirst. The vesicles upon the lips dried up, leaving in their places thin brown scurfs, which, upon the tenth day after the appearance of the former, fell off. Simultaneously with the development of the eruption in the mouth, numerous vesicles were formed upon the hands and fingers, which at first were of the size of a millet-seed, firm, and of a yellowish-white color, but in their further progress approximated in look to those in the mouth, healing, however, more slowly. Both the other physicians, who had also drunk the milk, exhibited, in addition to moderate febrile symptoms, vesicles in the mouth and upon the lips, the course of which was similar to that observed in the case of Hertwig; upon their hands, however, no vesicles were formed. At the termination of this process all three were restored to the best of health.

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[1] Medic. Jahrbücher des Oesterr. Staats, B. II. p. 86.

The great danger incurred from the consumption of unboiled milk, taken from cows suffering from foot-and-mouth disease, may be appreciated from the fact that young animals, especially sucklings, are destroyed thereby in great numbers, death ensuing as the result of gastro-enteritis. According to the statements of trustworthy observers, in many epizootics of this malady as many as seventy-five per cent. of the sucking calves of infected animals perish. To what extent this result is attributable to chemical alterations in the milk, or to the effects of the specific virus, is difficult to determine. It is certain, however, that such young animals are infected by the consumption of unboiled milk. Experience has shown that this milk is none the less dangerous to human beings, even when added to normal milk in the proportion of one to ten, or when taken with coffee. *By boiling, the virus is destroyed, and the milk rendered innocuous.*

In the case of adults, the consumption of a considerable quantity of milk is necessary for the production of infection.

As to the notion that the milk of diseased cows is not generally used, I can state from my own experience, that, during the prevalence of foot-and-mouth disease, the proprietors of large dairies indeed cease consuming milk in their own families, not, however, because they consider it injurious, but that they may be enabled to furnish to their customers in the city as nearly as possible the quantity contracted for.

Communication of foot-and-mouth disease, by means of the *meat* of diseased animals, is not known to have occurred, and is also improbable, inasmuch as that kind of meat is almost invariably cooked before being eaten. The case is different, however, with *butter* and *cheese* made from the milk of diseased cows. Several instances of infection, by the consumption of butter and cheese of this sort, are reported by J. Schneider,[1] who saw entire families made ill by their use. In view of our knowledge of the nature and tenacity of the specific poison, such modes of infection are to be regarded *à priori* as possible, and should receive, therefore, further study.

The second mode of infection, *direct infection*, is produced, in the majority of cases, by *milking* diseased cows, and permitting slight wounds, excoriations, and hangnails to come in contact with the contents of the vesicles upon the udders, or with the morbid secretion from the wounds and erosions on those parts. The *infection* may also result from taking care of diseased animals, if slight wounds upon the hands and fingers come in contact with their saliva and mucus.

In many cases the infection may be the result both of consuming the milk and of milking the animals.

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[1] *Heusinger*, Pathol. comparée, II. p. DVIII.

As regards the transference of this malady indirectly by communicating media, I have succeeded in finding in the literature of the subject only six cases reported by Hildebrandt.[1]

1. A boy contracted a very severe aphthous eruption in the mouth, after having, several days previously, bitten a pail that had been contaminated with the saliva of a diseased cow. 2. A man inoculated himself by holding between his teeth a knife smeared with saliva. 3. In like manner a young girl became affected with aphthæ in the mouth, after having held in her mouth a stick of wood that had been previously used in cleansing the mouth of a diseased cow.

Fuchs[2] reported an instance of the inoculation of three boys, from having been soiled with the dung of diseased animals. In this instance vesicles were developed upon the toes.

Respecting the predisposition of man to this malady, no accurate estimate can be made. The entire disease is comparatively unknown to the medical world, and in the great majority of cases, on account of the insignificance of the symptoms, does not come under medical treatment.[3] Human beings appear to possess no susceptibility whatever for the volatile form of the poison, and in general evince but a *moderate predisposition*, as may be inferred from the comparative infrequency of the malady in man, compared with its very extensive prevalence among domestic animals.

Dammann (Proskau), loc. cit., was unable to detect any ill effects either in himself, in pigs, or in lambs, from the prolonged consumption of the milk of diseased cows. Reynal likewise drank the milk of such animals with impunity.

The milk was also employed in certain instances in the treatment of invalids, without causing any bad results.

It should be stated emphatically, notwithstanding the popular notions on this subject to the contrary, that the disease occurs, at all events, much more frequently than medical men are inclined to admit.[4] It has been proved by repeated observations,[1] that at times, when foot-and-mouth disease prevails among animals, a kindred affection, and especially an aphthous eruption of the mouth, is noticed as occurring among children; the local manifestations as well as the general symptoms corresponding very nearly to each other in both cases.

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[1] Ibidem, II., p. CCCCXCVI.

[2] Thierärztl. Mittheilungen, 1870, No. VII.

[3] From the reasons above-mentioned there is found, in the journals and reports relating to veterinary medicine, a much more frequent allusion to this subject than in the ordinary medical journals.

[4] *McBride* affirms that in England, from 1839 to 1869, there were observed, in all, twenty-one cases of the infection of human beings with foot-and-mouth disease, a number which represents surely but a small fraction of the cases of infection that actually occurred.

Valleix described an epidemic of stomatitis occurring among children, in which ulcerations were also exhibited upon the joints of the fingers. Quite a number of men were attacked with aphthæ in the vicinity of Aix-la-Chapelle between the years 1838 and 1842, during which period foot-and-mouth disease was prevailing at that place (*Perty*, loc. cit.).

The attempt has been made (Heusinger, Hering) to account for the prevalence of these diseases at the same time, among both men and animals, by assuming the existence of a common miasma, an hypothesis which, in view of the definition already given of the specific infecting principle, is manifestly untenable. If we compare many of the forms of aphthæ (stomatitis ulcerosa) described in the text-books on diseases of children, such as frequently occur in epidemic form, with the following description of infectious aphthæ, induced by foot-and-mouth disease, there will certainly be found to exist a marked correspondence between the two.

The majority of the victims of this disease are *children*, and individuals employed in milking or taking care of the diseased animals. Adults are, upon the whole, less exposed to the disease, from the fact that they are not so accustomed as children to drink unboiled milk.

Symptomatology.

The period of incubation of foot-and-mouth disease in the human subject lasts, according to the clinical and experimental (Hertwig) facts upon record, from three to five days.

Whether infection has been produced by the consumption of milk, or by the direct inoculation of an abraded portion of the skin, there will be observed in both cases mild febrile symptoms, slight headache, and a sensation of dryness and heat in the mouth. In rare cases the disease begins with one or more chills.

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[1] *Kreutzer*, p. 822; *Hering*, Pathol. und Therapie, 3 Aufl., p. 367; Correspondenzblatt für schweizer Aerzte, 1872, p. 306, etc.

After this slight indisposition, combined usually with an impaired appetite, has lasted for several days,—the patient having, meanwhile, continued to drink the infected milk,—vesicles appear upon the lips and tongue, and less frequently also upon the hard palate and in the throat, conjoined with somewhat severer febrile symptoms. The vesicles may attain the size of a pea, their color being of a yellowish-white, and their contents whitish and turbid. In the course of a day or two these vesicles burst, and the desquamated epithelium becomes detached, leaving behind superficial, dark-red ulcers and erosions. Meanwhile the patient complains of pain in the mouth, which interferes with mastication, speaking, and swallowing. The lips seem swollen, there is a copious flow of mucus and saliva, and the mucous lining of the mouth presents a catarrhal redness. If the throat be affected by the process, a difficulty in swallowing is then created. In certain cases the tongue and inner surface of the lips become so sore after the discharge of the vesicles, and the separation of the epithelium, that no solid food can be taken for many days (stomatitis ulcerosa).

To the disorders above enumerated, coming on after the consumption of milk, there are almost invariably superadded *disturbances of the digestive function*, the symptoms of gastro-intestinal catarrh with fever, and frequently *the eruption of a vesicular exanthema upon the fingers and hands.* Children especially, who have consumed a large quantity of contaminated milk, will complain of pain in the lower part of the abdomen, and suffer from loss of appetite, and diarrhœa of more or less severity.

A variable number of small vesicles very often make their appearance upon the hands, about the nails, and upon the proximal ends of the fingers, being developed usually at the same time with the affection within the mouth. The vesicles are at first only the size of a millet-seed, and contain a transparent fluid; but they increase in size rapidly, while their contents become purulent, and of a turbid-white color, so that they present the appearance of ordinary pustules of medium size. The vesicles are, for the most part, separate and distinct, but some become confluent, especially those about the nails and the posterior aspect of the phalanges. The process of healing occupies usually from two to three weeks, and generally terminates without injury to the nail. In exceptional cases only there is developed a severe paronychia, accompanied by mortification and loss of the nail.

If the specific virus is transferred by the operation of *milking*, there will then be observed, at the expiration of the period of incubation, a vesicular eruption upon the hands, the course of which is precisely similar to the local process produced by the drinking of the milk. The patients complain at the same time of headache, a sensation of heat and smarting within the mouth, and dysphagia ; while, in addition to the eruption on the hands, red patches may appear here and there on the arms and breast, and, in rare instances, a vesicular eruption on the face. This latter eruption may show itself as well after a direct infection through the hands, as after drinking the milk, and presents frequently a resemblance to small-pox.

In one case an eruption covering the entire body was observed after the consumption of milk (Bircher). In another instance an eruption of bright red spots appeared on the lower extremities and the upper portion of the body, and these subsequently became covered with thin, whitish scales (Hislop).

All these cutaneous eruptions—the vesicles on the external surface of the lips, on the face and hands, associated occasionally with a very similar *eruption on the feet*,[1] between the toes—gradually dry up, and are converted into thin brownish scales, which, in the course of nine or ten days, fall off, though frequently a longer time, two or three weeks, is required before the healing process is completed.

There has been observed in extremely rare instances a vesicular exanthema on the breasts of women, analogous to the affection of the udder in the cow.

Nozcran (loc. cit.) observed an eruption of wart-like nodules on the breast of a woman, accompanied by decided indications of inflammation, all of which appeared after she had allowed her milk to be drawn by a sick lamb (the exact nature of whose malady was not determined). The tumors were so large as to require removal. Holm (loc. cit.) saw small vesicles developed on the nipple of a woman, shortly after her confinement. Scales were formed upon the seat of the vesicle, and in a few days recovery ensued. The patient suffered at the same time from angina tonsillaris. This woman had been drinking, daily, milk obtained from cows affected with foot-and-mouth disease, and had also been attended by a young girl who had herself milked these very cows.

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[1] A vesicular and papular eruption on the feet is rare, there being in all but three or four authentic instances on record.

There have been observed, in still rarer cases, in addition to the vesicles upon the inner surface of the lips, and the slight inflammation of the velum of the palate and the tonsils, a development of scales upon the mucous membrane of the nose, combined with symptoms of a peculiar catarrh. The stomatitis is sometimes accompanied by a severe glossitis. Briscoe describes a case in which the tongue became so swollen that it projected from the mouth to the extent of an inch and one quarter. Articulation became impossible, swallowing was rendered difficult, and respiration obstructed. Extensive ulcerations were formed at the same time on the mucous membrane of the mouth, though upon the external surface of the skin there was no appearance of any eruption. There was intense fever at the outset, and the patient was able to take nothing but liquid nourishment. The disease lasted four weeks.

The mildest forms of this affection appear to consist of an angina, accompanied by a catarrhal stomatitis.

The appearance of pustules and vesicles, not only on the hands, but also on the wrists, and furthermore, the development of a phlebitis proceeding from an ulcer upon the finger (Fangel), are worthy of mention as forming the less frequent concomitants of the disorder.

An inoculation succeeded by pretty severe symptoms came under the observation of Gaupp[1] (Schorndorf). A man, twenty-six years of age, who had the care of a cow suffering from foot-and-mouth disease, was seized with fever, vomiting of yellow matter, great prostration, pain in the forehead, racking pain in the joints, and a feeling of oppression about the chest, and was obliged to take to his bed. Upon the sixth day a vesicular eruption appeared on the chin, extending upward so as

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[1] In Hering's Repertorium der Thierheilkunde, 1872, p. 10.

LEEDS & WEST-RIDING
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to involve about one-half of the cheeks, and also on the dorsal surface of the hands and forearms. The vesicles were at first the size of a lentil, and were surrounded by a red areola; they gradually enlarged to the size of a pea, and became filled with a transparent lymph, which subsequently became more and more turbid. The eruption was accompanied by severe burning pains; the mucous membrane of the mouth became of a bright red color; from the salivary glands there was poured out a copious, viscid mucus, while the sublingual and maxillary glands were enlarged. The temperature of the body was elevated; the pulse moderately accelerated, and there was complaint of constipation, insomnia, and loss of appetite. The eruption which came out on the face and upper extremities, but which was absent from the rest of the body, resembled the exanthema of variola.

The *course* of the disease is, on the whole, mild. Young children only, who frequently lose all appetite, and in whom the disturbances of the digestive function (diarrhœa) assume a grave character, become exceedingly debilitated, and now and then succumb to the disease.

The *duration* of the entire process is variable. Recovery often takes place in from five to eight days, especially when the infection has resulted from an inoculation of the hands; as a rule, however, the affection is prolonged, as in the case of animals, to from ten to fourteen days, or even to three or four weeks. The prolonged duration is attributable to the fact that the ulcers on the hand, or within the mouth, assume a malignant character, and heal but slowly.

The *malady terminates* in the great majority of cases in recovery, a fatal issue resulting but rarely, and then usually in the case of a weakly, sucking infant.

Prëcy[1] observed in the case of sucking babies emaciation, and in several instances death under symptoms of uncontrollable diarrhœa. Zürn[2] reports the following case as having fallen under his observation: A herdsman, who had been handling with wounded hands several cattle suffering from foot-and-mouth disease, was attacked with fever, and subsequently with an aphthous eruption affecting the mouth and various portions of the body, and eventually died manifesting symptoms which could only be attributed to septicæmia. Ibid. p. 345: A child, which had been drinking unboiled milk, obtained from a cow suffering from foot-and-mouth disease, became affected with so many aphthæ and ulcers in the mucous lining of the digestive organs—as was observed by Zürn at the autopsy—that death ensued.

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[1] Repertorium der Thierheilkunde, 1873, p. 109.

[2] Die Schmarotzer auf und in dem Korper unserer Haussäugethiere, II., p. 344. Weimar, 1874.

A fatal illness in a child produced by drinking milk was furthermore observed[1] in the district of Aix-la-Chapelle

As regards the frequency and distribution of the disease in the human subject, the reader is referred to what has been already stated.

Diagnosis and Prognosis.

The diagnosis of the infectious aphthous disease is, with the aid of the previous history of the patient, by no means difficult to make. Whenever, during the prevalence of foot-and-mouth disease, large numbers of children, and especially those who have drunk the milk of diseased cows, are taken ill with the symptoms of an aphthous stomatitis, conjoined with disorder of the digestive functions, such cases are always to be regarded with suspicion. In like manner, every vesicular eruption appearing at such times on the hands and fingers of human beings who are in the habit of coming in contact with diseased animals, should excite the suspicion that an infection has occurred. The vesicular exanthema on the face may often be confounded with variola, or varicella, and the aphthous stomatitis with ulcerative stomatitis.

In doubtful cases, the diagnosis might be verified by the inoculation of smaller animals (goat, sheep).

The prognosis is, upon the whole, favorable. The epizootic aphthæ of our domestic animals, when communicated to human beings, is not a dangerous affection, no more than in the case of animals. Serious disturbances are produced only in very young children, and here assuredly an important rôle is played by the chemical alterations in the milk. It is possible that fatal results are produced in children by the diseased changes in the milk more frequently than is commonly supposed to be the case. As yet, however, only isolated cases of this character are known.

Prophylactic and Therapeutic Treatment.

Although the predisposition of man to this affection is pretty slight, and the course of the malady benign, it does not, nevertheless, seem unreasonable to demand that the milk obtained from cows suffering from foot-and-mouth disease should be subjected in some way to the control of the local sanitary officials, a measure which, up to the present time, has nowhere, so far as I know, been attempted. It will be a matter for further consideration whether the state prophylactic measures ought to be extended so as to forbid the sale of the milk so long as the animals show signs of fever, or while the milk exhibits any abnormal character, or whether they should be limited to a simple official notice to the effect that the malady is prevailing in such and such localities and stables, combined with a warning to milk consumers. Under no circumstances ought the milk of diseased animals to be consumed except after boiling. As we do not propose to enter into any discussion of the state measures for preventing the spread of the disease in animals, we may be permitted to append a few observations respecting the therapeutic treatment of epizootic aphthæ in the human subject.

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[1] Referred to by *Fuchs*, Thierärztl., Mittheilungen,, 1870, No. VII.

As in the case of foot-and-mouth disease in animals, so in the human subject, in order to promote the favorable progress of the entire process, it is above all important to abstain from all active therapeutic measures, and also to avoid all powerful applications to the affected parts. *The treatment should be symptomatic and principally dietetic.*

If the infection has been produced by the milk of diseased animals, care should first of all be taken to secure a supply of uncontaminated milk. If the stomatitis is extensive, the frequent application of a weak alkaline wash (borax in solution) to the cavity of the mouth may be recommended, with the view of neutralizing the excessive acidity. Cauterization of the painful erosions and ulcers, by means of solid nitrate of silver, serves to alleviate the pain, furnishes a protecting covering for the eroded surfaces, and facilitates cicatrization. Cooling drinks may usually be administered, but should be witheld in cases of severe diarrhœa.

The affections of the superficial integument (hands and fingers) should be treated in accordance with the general rules of surgery.

INFECTION BY THE BITE OR STING OF POISONOUS ANIMALS.

STINGS OF INSECTS.

Steffen, Infection durch Insectenstich. Deutsches Archiv für klin. Medicin, II. p. 192, 1866.—*Rique*, Ueber die Folgen von Fliegenstichen. Rec. de mém. de méd. milit., 3 Sér. 14, p. 472, 1865.—*Faure*, Piqûres de mouches. Gaz. des Hôpitaux, No. 66, 1868.

Nivison, Fatal Result of a Bee Sting. New York Journ., May, 1857.—*Ewens*, Death from Bee Sting. Med. Times and Gaz., 1860, p. 389.—*Finkh*, Tod nach einem Wespenstich. Würtemb. Corresp.-Blatt, XXXI, 35, 1861.—*Michel*, Schneller Tod in Folge eines Wespenstichs. Würtemb. Corresp.-Blatt, XXXII, 1, 1862. —*O'Donnell*, *W.*, Poisoning by a Bee Sting. New York Med. Rec., II. No. 43, 1867.—*Hawelka*, Infection durch einen Wespenstich. Wien. med. Presse, No. 32, 1869.—*Thompson*, *D.*, Death from Bee Stings. Brit. Med. Journ., April 24, p. 374, 1869.—*Terry*, *G.*, Wasp Stings. Brit. Med. Journ., Sept. 2, 1871.—*Drury*, *C.*, Wasp Stings. Brit. Med. Journ., Sept. 23, p. 351, 1871.—Bienenstich, Corresp.-Blatt, für schweizer Aerzte, p. 583, 1872.

Cavaroz, Ueber den Biss des Scorpion von Durango. Rec. de mém. de méd., etc., milit., 3 Sér., XIII, p. 327, 1865.—*Heinzel*, Ueber Scorpionenstich. Wochenbl. der Gesellsch. der wiener Aerzte, 1866, p. 323.—*Dalange*, Des piqûres par les scorpions d'Afrique. Rec. de Mém. de méd. milit., 1866, p. 136.—*Guyon*, Sur un phénomène produit par la piqûre du Scorpion. Compt. rend. Vol. LXIV. p. 1001, 1867.—*London*, Ein Fall von Verletzung durch Scorpionstich. Wien. med. Presse, No. 6, 1869.—*Jousset*, Essai sur le venin du scorpion. Compt. rend., LXXI., No. 10, p. 407, 1870.—*Posada-Arango*, *A.*, Note sur les scorpions de la Colombie. Arch. de méd. navale, XVI., 213, and Gaz. des Hôpit., No. 121, 1871.

Wood, *H. C.*, Effect of the Bite of the Scolopendra heros (Centipede). Amer. Journ. of Med. Sciences, 1866, p. 575.—*Sébastiany*, Piqûre de la Scolopendre mordante. Gaz. des Hôpit., No. 91, 1870.

Frantzius, *v. A.*, Vergiftete Wunden bei Thieren und Menschen durch den Biss der in Costa-Rica vorkommenden Minirspinne. Virchow's Archiv f. path. Anat., Bd. 47, p. 235, 1869.— *Wright*, The Katipo, or Poison Spider of New Zealand. Med. Times and Gaz., Nov. 12, p. 570, 1870.—*Ucke*, Vergiftungen durch Spinnenbisse in der Kirgisensteppe im Sommer 1869. Petersb. med. Zeitschrift, .1870, 1 Heft, p. 54.

Heinzel, Ueber Tarantelbiss. Wochenbl. der Gesellschaft der wiener Aerzte, 1866, p. 255.

Compare further, *Billroth, Th.*, Von den vergifteten Wunden, Handbuch der allg. u. spec. Chirurgie, v. Pitha u. Billroth, B. I, II Abth., III Abschn., p. 86; also, Die Jahresberichte über die Leistungen, etc., in der gesammten Medicin, von Virchow und Hirsch: *A. Hirsch*, Acute Infectionskrankheiten, B. II v. 1866–1872.

There exist numerous insects which have the power of producing in man, by their sting, inflammation and poisoning of greater or less severity. Passing over the cutaneous parasites, which are treated of in another portion of this work, and also a variety of flies, gnats, and mosquitoes, we come to certain hymenoptera (bees, wasps, hornets), arachnida (scorpions, spiders), and some forms of the myriapoda (scolopendra), which especially demand our attention.

1. *Infection by the sting of insects*, and especially by that of certain flies, is an affair of frequent occurrence, yet it is impossible to state with certainty whether the sting forms in itself the injurious agent, or whether the insect serves merely as the vehicle for the implantation of some other virus (*e.g.*, cadaveric poison, or the poison of malignant pustule). Such cases of infection by insect stings are often characterized by very severe symptoms, and frequently terminate fatally. There is commonly found at the seat of the sting a very painful tumefaction, with deep-seated inflammation and an infiltration of the surrounding tissue. As a result of the constitutional infection, there will also be observed an intense fever, great restlessness, and inflammations of the internal organs. Steffen describes a case of this sort occurring in a boy, ten years old, which terminated fatally.

2. *Infection by the sting of bees, wasps, and hornets.*

The so-called hymenoptera constitute the order of the poisonous stinging insects (hymenoptera aculeata), and are characterized essentially by being provided with a denticulated sting, into which the excretory duct of the poison-bladder opens. The poison-bladder receives the secretion of two pyriform glands. The contents of this bladder are ejaculated into the small wounds made by the sting, giving rise to a pretty severe and painful inflammation. The skin at these points becomes indurated and reddened to a varied extent. The pain, redness, and swelling disappear, as a rule, in the course of a few hours, but in many instances continue for one or two days. Suppuration rarely ensues.

Wounds of this character have, in rare instances, been known to be followed by symptoms of blood-poisoning, and now and then by a fatal result. Such dangerous stings are mostly inflicted in certain special parts of the body, as for instance near the eyes, ears, and lips, and occur in feeble women or in old persons. The constitutional symptoms are usually nausea, faintness, great weakness, vomiting, præcordial distress, difficulty in breathing, also coldness of the extremities, and frequently petechiæ on the body, or the general eruption of a pale-reddish exanthema, either resembling that of measles, or in the form of wheals, with intense itching. Less frequently an excessive thirst is experienced, and a hoarseness increasing to an absolute aphonia. In place of the slight redness and swelling in the vicinity of the sting, there appear at times an extensive tumefaction and lividity, which may involve a large portion of the affected limb, or even the entire body. These phenomena last for several hours, disappearing in favorable cases speedily, or within a few days. In many instances death ensues within a quarter of an hour, or even a few moments. It is probable that in such cases the virus has been ejected from the sting directly into a blood-vessel.

A fatal result may likewise ensue when human beings, particularly children, are attacked by an entire swarm of these insects, or when the seat of the sting is in the throat. The latter accident happens when fruits or liquids are taken into the mouth, in which some insect of this order happens to be concealed, the puncture being inflicted in the mucous membrane by the insect on its way down. In consequence of the acute swelling and the œdema of the glottis, suffocation may be produced within a very short time.

3. *Infection by the sting of scorpions.*

Scorpions—belonging to the order of arachnida—are composed of a short cephalo-thorax, which articulates along its entire breadth with the abdomen. The latter is divided into two parts, a cylindrical anterior portion, composed of seven joints, and a compressed, caudiform, posterior portion, terminating in an incurved sting, provided with two poison glands.

Scorpions inhabit hot countries, and are met with in Europe as far north as the southern slope of the Alps. They live under stones and the bark of trees, in the sand, or beneath plants, making their way also into houses. The most important species are: The European scorpion (sc. europæus) of Italy, the Tyrol, and southern France; the scorpio occitanus of northern Africa, southern Spain, and southern France; and the scorpio afer, the largest and most dangerous of all, inhabiting Asia and Africa. Scorpions are also found frequently in Texas, Syria, New Granada (Colombia), and in Algiers.

Jousset describes the contents of the poison-bladder as a colorless, clear liquid, of an acid reaction, whose specific gravity is somewhat higher than that of water. Microscopically, the poison appears perfectly transparent. Epithelial cells and a finely granular mass are found in it, but these elements are not constant. Within the poison-bladder of a medium-sized scorpion (*sc. occitanus*) there are found about two milligrammes of poison, a quantity sufficient to destroy rapidly a medium-sized dog. According to the experiments of Jousset on frogs, the poison attacks at once the red blood-corpuscles, causing them to adhere to one another, and thus forming masses which plug the capillaries, and thereby obstruct the circulation.

Heinzel performed experiments upon frogs and birds; both die within a few seconds after the sting of a scorpion, death taking place—as when curare has been administered—without convulsions, from paralysis of the peripheral nerves, respiration being accelerated. Guyon, in his experiments with scorpion poison upon dogs and guinea-pigs, noticed *violent erections of the penis*, a symptom which was also observed by Delange in Algiers in the human subject. Guyot,[1] in the course of his experiments, saw a guinea-pig destroyed in fifteen minutes, and a large dog in fifty minut

The action of the poison is influenced by the size and strength of the wounded animal, the quantity of the poison introduced, the number of stings, and the susceptibility of the wounded individual. The symptoms are said to be more severe in summer than in winter. Children incur greater danger than adults.

The European scorpion gives rise by its sting to an acute, local, and painful inflammation, which generally disappears in the course of a few hours. The large scorpions of hot countries (Syria), on the other hand, are much more formidable. Their sting is quite virulent, acting more energetically in many cases than the poison of a serpent. In the fatal cases, such as occur frequently in Algiers, especially in children and debilitated persons, there are observed, as the most important symptoms, lividity of the face, cyanosis of the lips, weakened pulsation of the heart, a small and retarded pulse, erections of the penis, great restlessness, severe vomiting, involuntary fæcal evacuations, and finally, at the expiration of several hours, death, with symptoms of œdema of the lungs. At other times, after the manifestation of very violent symptoms of constitutional infection—with convulsions, unconsciousness, and excited action of the heart—the patient is restored to health upon the third or fourth day. Posada-Arango (New Granada) points out a symptom which he regards as pathognomonic, and quite independent of the wound, viz.: a sensation of numbness and heaviness in the tongue, coming on immediately after the injury, a form of paresis of the lingual and hypoglossal nerves, rendering it difficult to move that organ, and interfering with speech. At the same time the senses of taste and touch appear to be impaired.

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[1] Jour. de méd. vét. de Lyon, T. VIII. p. 191, 1852.

4. *Infection by the Bite of Spiders.*

Spiders, belonging also to the class of *arachnida*, are armed with hook-shaped mandibles, moving horizontally, at the apex of which the excretory duct of the poison-gland empties. The virus pouring into the wound (produced by the blow of the claw), causes in the smaller animals instantaneous death.

The bite of the bird-spider of South America (*mygale avicularia*), which has a body of from two to two and a half inches in length, is said to produce in man a prolonged inflammation, with suppuration and callous cicatrization (Schmarda).

The bite of the *scorpion spider of Costa Rica*, of the genus *Mygale*, proves dangerous to man in rare cases only. It never bites except when irritated or disturbed, wounding generally in the feet or in the scrotum. The bite produces no general infection, there being merely a superficial and rapidly spreading dermatitis, with serous exudation. The bitten persons experience severe smarting pains; vesicles are formed at the seat of the wound, which are filled with a sero-mucous fluid. After the epidermis becomes detached, there remains an ulcerated surface, which, like erysipelas, spreads rapidly upon the periphery (v. Frantzius), and forms the seat of a copious secretion.

In the steppes of the Kirgheez there is found a spider (*Latrodectus lugubris*) which measures about half an inch in length, and which is extremely dangerous, especially to large animals. One-fifth of all those bitten are destroyed, although of human beings thus wounded only four per cent. die. There is experienced, after the wound, a smarting pain at the seat of the puncture, gradually extending over the limbs and entire body, while there is an absence of all redness and swelling. This is rapidly followed by cold sweats, restlessness, dizziness, mental anxiety, depression, vomiting, cyanosis, convulsions, and a typhoid condition. These symptoms do not abate before the third or fourth day, while a fatal result may occur after two or three days (Ucke).

The *katipo spider* of *New Zealand*, by its bite, produces a white vesicle at the seat of the wound, which is surrounded by a red areola, and is attended by severe pain. The pulse is scarcely perceptible, and greatly retarded. Great dyspnœa is observed, with lividity of the face, and cold extremities. If appropriate treatment is employed, the symptoms gradually disappear, and recovery ensues in the course of a few days (Wright).

In the *South* of *France* and in *Spain*, especially in the vicinity of Tarragona, there is found a spider that is greatly feared on account of its bite (the *aranea tredecim guttata, theridium malmignata*), measuring nearly half an inch in length, and furnished with largely developed poison-glands. The virus is thought to exercise a specific action upon the nervous and muscular systems. The effects of the poisoning disappear within a short time, although, in many instances, especially in the heat of the summer, a feeling of uneasiness remains (Schmarda).

The tarantula (*lycosa tarantula*) is met with in Italy, and is greatly feared; it measures as much as an inch and a half in length, and lives in holes, which it digs in the ground. The phenomena following the bite are similar to those of other insects already described. The notion that persons bitten by the tarantula fall into a state of delirium, accompanied by an excessive avidity for dancing (tarantismus), originates in a wide-spread vulgar superstition, and is entirely unsupported by facts. Heinzel, who experimented upon himself with a tarantula obtained from Syria, experienced, after receiving a bite in the hand, a slight sensation of tension in the arm. An eruption of wheals with a red areola appeared, but aside from this there were no local manifestations, nor any nervous anxiety.

5. *Infection by the bite of scolopendra* (centipedes).

The *scolopendrina*—of the order of *Myriapoda*—are insects composed of several joints, and have an elongated, cylindrical body, each of whose numerous segments is provided with a pair of feet. The anterior pair of feet, attached near the head, are employed in the prehension of food. These form a sort of "foot-jaw," the anterior free portion of which contains more joints, and is provided with poison-glands and a terminal claw capable of inflicting a wound. These mandibles enable centipedes to transfix other animals and destroy them by the poison that is discharged into the wound. The *scolopendra morsitans* is found in large numbers in southern Europe; it lives beneath damp stones and old walls.

The symptoms occurring after the bite are as follow: At first an itching is experienced, which is soon followed by an intense pain, which extends to the entire limb. At the seat of the puncture a red spot appears, which gradually enlarges and becomes, finally, perfectly black in the centre, as in the case of malignant pustule. Lymphangitis and lymphadenitis of the adjacent lymphatic glands frequently supervene. The constitutional symptoms consist of great mental anxiety, pain in the limbs, irregularity of the pulse, dizziness, headache, and vomiting. In rare instances death results, with convulsions, even within five or six hours, as has been often observed in Texas, for instance, after the bite of the *scolopendra heros* (Wood).

Treatment.

The treatment of all the stings and bites above described is about the same. The best applications are cold compresses, ice, lead-water, and ammonia. In wounds inflicted by the *hymenoptera*, it is well to ascertain whether the sting has been left in the wound, and this, if found, should be extracted with a fine forceps. In the case of spider bites, the withdrawal of the virus by a cupping-glass, and the application of the actual cautery to the wound, can also be resorted to.

The *local application of ammonia*, combined often with the internal administration of water of ammonia, has been proved by experience in all these poisonings to be attended by favorable results, and its employment seems reasonable, inasmuch as when applied externally it has the effect of neutralizing the acrid virus. A favorite internal remedy is water of ammonia combined with brandy or hot tea, with the view of producing, at the same time, diaphoresis.

Dalange recommends, in the case of a scorpion sting, the application of a firm ligature above the seat of the wound, also three or four incisions, from a quarter to half an inch in length, over the wound, and, finally, the employment of suction by the mouth. In New Granada a popular remedy is employed with success to relieve the peculiar paresis of the tongue in the case of scorpion stings; this consists in holding in the mouth the slice of a very sour lemon.

In the case of centipede bites Sébastiany advises the internal administration of fifteen grains of carbolic acid, combined with thirty of chloral, and external astringent applications.

SNAKE-BITES.

Fontana, Traité sur les venins de la Vipère. Florence, 1781.—*Canton*, Viper Bite in the Thumb. Lancet, II, Aug. 6, 1857.—*Heinzel*, Zur Pathologie und Therapie der Vergiftung durch Vipernbiss. Wochenbl. der Ges. der Wien. Aerzte, 1866, p. 169. Ibidem, 1867, Nos. 16 and 17.—*Encognère*, Des accidents causés par la piqûre du serpent de la Martinique. Montpellier, 1865.—*Boullet, L. J.*, Étude sur la morsure de vipère. Paris, 1867.—*Viaud-Grand-Marais*, De la létalité de la morsure des vipères. Gazette des Hôpitaux, Nos. 62 and 65, 1868. Ibidem, 1869, Nos. 48, 49, and 54.—*Chéron* et *Goujon*, Sur l'action du venin de la vipère. Compt. rend., LXVII., No. 19. 1868.—*Mandic*, Zur Casuistik des Vipernbisses. Wien. med. Presse, Nos. 25-27, 1871.—*Fischer*, Ein Biss der Kreuzotter (Viperus Berus). Zeitschrift für Wundärzte und Geburtshelfer,

1872, p. 95.—*Fredet*, Cas de mort par la morsure d'une vipère. Gaz. des Hôpit., 1872, No. 106.—Vipernbiss, Corresp.-Blatt für schweiz. Aerzte, 1872, p. 308.—*Putz*, Zur Behandlung des Schlangenbisses durch subcutane Injection von liq. ammon. caust. Berlin. klin. Wochenschr., 1873, No. 28.

Imlach, Mortality in Consequence of Snake-Bites in the Province of Scind. Transact. of the Med. and Phys. Soc. of Bombay, 1855 and 1856; also in Arch. gén., Dec. 1857, p. 735.—*Mitchell, S. W.*, Researches upon the Venom of the Rattlesnake. Washington, 1861. The Venom of Serpents. Med. Times and Gaz., 1869, Feb. 6. Observations on Poisoning with Rattlesnake Venom. Amer. Journal of Med. Sciences, April, 1870, p. 317.—*Halford, G. B.*, Experiments on the Poison of the Cobra-de-Capello. Brit. Med. Jour., 1867, pp. 53 and 563. On the Treatment of Snake-Bites. Dobell's Reports on the Progress of Practical and Scientific Medicine, Vol. II., p. 447, 1871.—*Jones, J.*, Experiments with the Poison of the American Copperhead. New York Med. Record, p. 289, 1868.—*Shortt, J.*, Experiments with the Poison of the Cobra-de-Capello. Lancet, p. 556, p. 615, 1868.—*Fayrer, J.*, On the Action of the Cobra Poison. Edin. Med. Jour., 1868, p. 522, 1869 and 1870. The Thanatophidia of India; being a Description of the Venomous Snakes of the Indian Peninsula, with an Account of the Influence of their Poison on Life, etc. London, folio, 1872—*Ogle, W.*, Loss of Speech from the Bite of Venomous Snakes. St. George's Hos. Rep., III, p. 167, 1868.—*Berge*, Trois cas de morsure par serpents à sonnettes. Rec. de mém. de méd. milit., 1869, p. 168.

Compare *A. Hirsch*, Acute Infectious Diseases, in the Jahresbericht über die Fortschritte und Leistungen in der gesammten Medicin von Virchow u. Hirsch, 1866–1872, Bd. II.

Snakes—belonging to the class of reptiles—are armed with solid incurved teeth, which are intended merely to enable them to fasten upon their prey; and some varieties are also provided, in addition, with *hollow or grooved fangs*, which form the excretory duct of a poison-gland, and conduct into the wound the poison expressed by the action of the temporal muscle. The poison-fangs, which are furnished with a central tubular cavity, are situated in the small upper jaws, one on each side. The teeth, which are at first movable, after their complete development, become firmly attached to the upper jaw, which is movable. When the animal is at rest, the fangs occupy a horizontal position, being concealed in a fold of the gum, but when the mouth is opened, they become erected by the action of the so-called quadrate bone, by which motion the upper opening of the tubular cavity is connected with the orifice of the duct of the poison-gland. Each poison-gland corresponds to a parotid gland,

and is composed of a similar structure. The excretory duct is slightly tortuous, and, just before its point of union with the fang, is provided with a powerful constrictor muscle. As the act of biting is produced by the forcible closure of the jaws, in like manner, by the action of the temporal muscle, the poison-gland is compressed, and the poison ejaculated, and with such force that, in the case of rattlesnakes, for instance, the poison may be ejected to a distance of several feet.

Respecting the habits of snakes, it may be remarked that the majority of them inhabit tropical countries, and live for the most part in the woods, beneath the foliage, and in holes in the ground. Some varieties are in the habit of climbing trees and bushes, while others live in the water or in the sea.

Systematic Classification of the Venomous Snakes.

I. *Sub-order : Vipers* (*Viperina*). The upper jaw is very short, and contains no other teeth behind the hollow, ungrooved poison-fangs.

1. *Family : Burrowing vipers* (*Crotalidæ*). A deep pit on each side of the head between the nostril and the eye. The tail is prehensile, and is furnished with horny appendages. America and Asia.

Rattlesnake (*Crotalus*). Tail furnished with a rattle. Rattlesnake (*Cr. durissus*), south-eastern part of North America, Mexico, and as far south as Surinam. Cascavella (*Cr. horridus*, banded rattlesnake), South America.

Silent rattlesnake (*Lachesis*).

Triangular-headed snake (*Trigonocephalus*).

2. *Family : Viperidæ.* No pit between the eyes and nostril. Tail non-prehensile and destitute of horny appendages. Eastern hemisphere.

Viper (*Vipera*). Hind portion of the head very broad, and its outlines sharply defined. *Common adder* (adder, Kreuzotter, Feuer-, Kupfer-, Höllennatter, *vipera*, or *Pelias Berus*). Covered on the summit of the head with regular plates. Color quite varied. A sure distinguishing sign is a dark-colored, *zigzag stripe* on the back, slightly raised above the ground color. It inhabits damp and wooded localities in mountainous countries, living in the clefts of rocks and in shrubbery. It is met with pretty often in Central Europe. The *shield-viper* (*Vipera aspis, Vipera Redi*). Summit of the head covered with scales only; in other respects very similar to the common adder. The back without a zigzag band, but covered with large, distinct, dark spots. Found principally in the south-western countries of Europe. *Sand-viper* (*Vipera ammodytes*) in Italy.

II. *Sub-order. Venomous serpents* (*Colubrina venenosa*). The upper jaw is furnished with grooved fangs, behind which are a few solid teeth, though in some varieties there are no other teeth.

1. *Family: The genuine venomous serpents* (*Elapidæ*). Body almost cylindrical; tail short and pointed; nostrils on the side.

Elaps (*Prunkotter*). Many varieties in America, Asia, and Africa.

Rock-serpent (*Bungarus*). East Indies.

Shield-viper (*Naja*). This has the power of moving the front ribs, and thereby distending the region of the neck, in the form of a disk. *Spectacled-snake* (*cobra-de-capello*, or *hooded-snake*).

2. *Family: Sea-serpents* (*Hydrophidæ*). Body and tail compressed laterally. Nostrils on the upper part of the head. In the Indian and Pacific Oceans.

A. Viper Bites.

In Central Europe (Germany, France, and Switzerland) there are found two species of snakes which are moderately dangerous, viz.: the *shield viper* (*Schildotter*, *Vipera Redi*, *Vipera aspis*), about three feet long, of a reddish-yellow color, and covered with black spots, and also the *common viper* (*Kreuzotter*, *Vipera Berus*, *Vipera Pelias*), with the characteristic zigzag band on the back.

In the Alps there is often found a black species of the common viper—*Vipera prester*—an irregular variety of the common female viper, which mates with the male of this species and commonly produces the common viper, to which, likewise, it corresponds in respect to its venomous properties and mode of life.

Next after Fontana, whose work was classical even down to a recent date, we are indebted to Heinzel, Boullet, and Viaud-Grand-Marais for valuable observations respecting viper bites.

Both varieties of vipers, Vip. Redi, and Vip. Berus, are equally venomous; they bite, as a rule, only when irritated, or in self-defence. The virulence of the poison is the greatest in the spring (after hibernation), in the hot season, when the poison appears to be the most concentrated, and finally, when the poison glands are completely filled. According to Fontana, the total quantity of the poison in both glands amounts to at most ten centigrammes. The poison is of a clear, yellowish color.

The wounds produced by the bite, as is the case with venomous serpents generally, are of a *penetrating* character, and two in number, thus, · · ; whereas the wounds inflicted by a non-venomous snake are of a zigzag shape, ʃʅ . In consequence of the curved outline of the poisonous fangs, the wound likewise presents a curved shape, and upon those portions of the body which the snakes are unable to grasp with their jaws it penetrates but a short distance (about one millimetre) into the tissues; in other parts—upon the fingers and toes—the wound equals in depth the entire length of the fang which has been forced into it. The head of the viper may inflict a wound even after it has been separated from the body (Viaud-Grand-Marais). It rarely happens that several bites are inflicted by the same reptile.

Of forty-five cases terminating fatally, twenty-six were ascertained to be males, and twenty-one females. One-half of the fatal cases occurred in children under the age of fifteen.

The seat of the wound is, as a rule, upon the leg, and usually in the vicinity of the ankle-joint, less frequently, by far, on the head, face (in children), breast, or other portion of the trunk.

Small animals (frogs, toads, rabbits) die almost invariably after the viper bite; dogs and sheep less frequently, while in larger animals (horses, cattle) the wound is never fatal. The hog, pole-cat, and hedgehog are said to be insusceptible to the virus.

Symptomatology.

Immediately after the infliction of the bite, the wounded person experiences a pain, more or less severe, at the seat of the injury. A few drops of blood ooze from the two small wounds, around which a livid redness very soon appears, attended by extensive tumefaction. The *inflammatory swelling* generally supervenes within an hour after the infliction of the wound, and frequently attains a considerable size, involving a large extent of tissue, but recedes usually in from four to eight days. Meanwhile, pain is experienced in the seat of the wound and its immediate vicinity, while the injured part feels to the patient benumbed, its temperature falling to 86° or 88° Fahr. Within a few hours or a day after the injury, livid spots make their appearance, which are quite characteristic; these spread from the wounded part in all directions. Phlyctænæ and gangrene are produced at the seat of the wound, due in part to the therapeutic measures resorted to (ligatures, ammonia).

The *secondary constitutional symptoms*, which often supervene within a few moments, and generally in one-half, one, or two hours, are faintness, loss of consciousness, chilly sensations, cold clammy sweats, small, irregular pulse, gasping for breath, sunken eyes, *facies Hippocratica*, general prostration, intense thirst, vomiting, præcordial distress, occasional diarrhœa, icterus, more or less severe, and complete suppression of the urinary secretion. In severe cases the patient is seized with cramps, convulsions, delirium, and involuntary evacuations of urine and fæces, both of which are often mixed with blood.

The symptoms of paralysis affecting the motor nerves, beginning at the periphery and extending towards the centre, afford a significant indication that the system has been infected. In this case, as happens after the administration of curare, the paralysis first affects the extremities of the motor nerves, then the nerve trunks of the voluntary muscles, afterwards the nerve-centres, and finally the sensory nerves.

In the fatal cases, which are attributable to the blood-poisoning produced by the direct introduction of the virus into the circulation, the shortest duration of the illness is from one to two hours, though it usually lasts from a number of hours to several days. Death results with symptoms of nervous prostration and asphyxia.

If the disease terminates favorably, a gradual amelioration of the local and general symptoms takes place, profuse perspiration being often observed at the crisis.

A *fatal result* ensues in 25 per cent. of the cases within the first twenty-four hours, in 50 per cent. between the second and sixth days, in 25 per cent. between the seventh and twenty-first days, and in a few cases only after the lapse of several months, in consequence of general cachexia.

As *sequelæ*, there are frequently observed an œdema and weakness of the injured part, which continue for a considerable length of time; furthermore, paralysis and nervous disturbances.

The *prognosis* of the viper bite is, as a rule, by no means unfavorable. The danger to be apprehended from a bite depends upon the *quantity of the poison*, in which connection are to be considered the size of the reptile and of the individual bitten, the time that has elapsed since the last bite previously inflicted by it, the number of the wounds made, and the extent to which the animal has been irritated; also upon the depth of the bite, and the locality of the wound,—wounds of the blood-vessels being the most formidable, while bites in fatty, non-vascular portions of the body are less to be feared; finally, upon the constitution of the patient and upon the treatment.

Although the mortality from viper bites in the Department Loiret amounted, according to Boullet, to only one per cent. (two fatal cases out of 200 persons bitten), it is stated by Viaud-Grand-Marais that in the Vendée, and the Department Noire-Inférieure 14 per cent. died (of 316 persons bitten 44 died). Whether this difference is to be ascribed solely to the treatment, or to other local conditions, it is difficult to say. Of 50 cases of viper bite collated by Fontana, two only terminated fatally. Upon the average, therefore, the rate of mortality would amount to 8.5 per cent. (of 566 persons bitten, 48 died).

The *diagnosis* presents no difficulties, provided that we are informed of the previous history of the case. If the physician is in doubt as to whether the bite was inflicted by a venomous or non-venomous reptile, this point can be determined by the shape of the wounds, as above described. The wound made by the bite of a non-venomous snake is of a zigzag shape, while that of venomous snakes presents the appearance of two round apertures.

Treatment.

The most important indications presented in the treatment of a case of poisoning by a viper bite are (Heinzel):

1. *Prevention of the absorption of the poison* by such measures as the application of the cupping-glass, or compression at the seat of the injury with the finger or tourniquet;—the ligature applied above the wound must be broad, and should not be drawn too tight.

2. *The withdrawal of the poison as soon as possible*, by washing or squeezing the wound, by means of suction by the mouth, application of a cupping-glass after moderately deep incisions

have been made across the seat of the bite, or by amputation of the injured limb, in case the wound is situated upon a finger or toe.

3. *Local destruction or neutralization of the poison* by the application of the red-hot iron, of caustics (nitrate of silver, caustic potash), or of ammonia.

4. The *disinfection of the blood* by the internal administration of ammonia, iodine, bromine, or chlorine. As to the action of ammonia, there is a great diversity of opinion. Bromide of potash has recently come into repute as being efficacious.

In case of collapse, wine should be given. Mild stimulants (good mulled wine, tea with brandy) always do good service, when administered from the outset. Enveloping the parts in cold wet cloths has been likewise recommended.

The subcutaneous injection of water of ammonia, diluted with an equal quantity of water, while the same agent is given internally in drinking-water, has been recently proposed by Halford, and has been resorted to in several instances with success (Putz *et al.*). There is this objection, however, to the subcutaneous administration of ammonia, that it is apt to produce a slight sloughing at the seat of the puncture, on which account milder solutions may be preferable. In accordance with the experience of physicians in India, Halford's method of treatment for snake-bite is of no effect.

Fontana[1] was likewise in his time familiar with this mode of treatment, and made an experimental trial of it upon animals. His experiments upon sheep and hares resulted unfavorably, but in the case of human beings his success was astonishing.

In countries infested with vipers, it is to be recommended as a *prophylactic* measure, that those persons who are exposed to the danger of being bitten (wood-choppers, huntsmen, herdsmen, children), should protect their feet by wearing high boots, and thus avoid all risk of being wounded. Vipers are unable to raise themselves higher than the tops of the boots, nor can they penetrate leather.

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[1] *Fontana*, Opusculi scientifici di Felice Fontana, p. 125. Florence, 1782.

B. Snake-Bites.

The pathology of snake poisoning has been greatly enriched during the past few years by a series of careful observations, among which those of Halford, Shortt, Mitchell, and above all those of Fayrer, are deserving of mention. Referring the reader to the monograph of Fayrer (1872) upon the venomous snakes of India, we will content ourselves with a brief allusion to some of the more important points of our subject.

The most dangerous varieties of venomous snakes met with in India are the spectacled snake (*cobra*, *cobra-de-capello*, *naja tripudians*), the rock-snake (*bungarus cæruleus*), *bungarus fascialus*, *ophiophagus elaps* (hamadryas); of the vipers found in India, *daboia Russellii* and *echis carinata;* furthermore, of the water-snakes, *hydrophis* and others. In America, the rattlesnake (crotalus) and the copperhead (trigonocephalus) are regarded as the most formidable of the venomous snakes.

The poison of the cobra-de-capello, the most dangerous of the venomous snakes of India, is composed (according to the report of Armstrong and Brunton, of London, to whom it was submitted by Fayrer for analysis) of a brownish fluid of the consistence of syrup, containing from forty-three to forty-five per cent. of carbon, and from thirteen to fourteen per cent. of nitrogen. It invariably coagulates upon the addition of nitric acid or alcohol, and also upon the application of heat. It was found impossible to produce from it in any way a crystallizable substance. The presence of a substance containing albumen can be demonstrated by various reactions. It was proved by experiments, that the poison, which had been sent to them, and also the preparations that had been formed from it, preserved unaltered and unimpaired their peculiar venomous properties.

According to Shortt (Madras), the cobra poison is composed of an oily, clear, bright yellow-colored fluid, similar to albumen, having a specific gravity of 1.046. Its reaction is *acid;* it contains albuminoid matter, but no mucus. When placed upon the tongue, it produces a burning sensation, causing the formation of vesicles, and a feeling of numbness in the part to which it is applied. It contains twenty per cent. of solid substances.

When the virus was mixed with a solution of potash, it was always rendered inactive, although the application of this agent externally and internally, after the reception of a bite, proved futile.

A microscopical examination showed the presence of cells, suspended in an albuminoid fluid.

Halford suggested the theory that organized germinal matter was thrown into the poisoned organism together with the virus, which rapidly developed and multiplied, the process going on at the expense of the oxygen. He maintained, therefore, that death would be produced in the case of snake-bite by a want of oxygen, just as in the case of death from suffocation. Fayrer was unable to confirm this theory. According to the latter, the alterations in the character of the blood after snake-bites consist principally in this, that after the bite of vipers (daboia) the blood remains fluid, while it quickly coagulates after the bite of the cobra-de-capello. The blood of an animal killed by a snake poison has the effect of poisoning other animals when injected into them; but the flesh of such animals can be consumed without any ill effeet. The cells described by Halford, as being found in the blood of animals destroyed by snake poison, were demonstrated by Richardson, after repeated microscopical examinations, to be simply colorless blood-corpuscles.

According to the observations of Fayrer, no animal possesses an immunity against the action of snake poison, except the venomous snakes themselves. Venomous snakes belonging to the same variety are unable to poison one another, although, in exceptional cases, those of different varieties may poison each other. The non-venomous serpents are as susceptible to snake poison as other animals. Warm-blooded animals are the most quickly affected by the action of the poison, and especially birds. The degree of rapidity with which death ensues bears generally a definite relation to the size of the animal upon which the bite is inflicted; so that small animals—with certain exceptions—succumb more quickly than larger ones. The result of the bite is influenced materially by the species of the snake inflicting the wound, and its size and strength, or, in other words, upon the quantity and quality of the virus introduced by the bite.

The poison of the copperhead (trigonocephalus contortrix) is far less virulent in its action than that of the rattlesnake. *Each variety of snake poison, when taken into the stomach, is abso-*

lutely innocuous (Mitchell), whereas it is quickly absorbed by the small bronchi and alveoli of the lungs, and develops its full strength. Mitchell observed, upon applying the snake poison to the mesentery of rabbits, that red blood-corpuscles immediately appeared on the outer walls of the capillaries, accumulating in such masses as to compress the vessels, and impede or completely obstruct the circulation. Within five or ten minutes the entire field of vision becomes covered with extravasated blood, the origin of which can only be referred to some alteration in the walls of the vessels.

Respecting the *frequency* of snake-bites, Fayrer makes the following statement :

> In India, of a population of 121,000,000, 11,416 deaths from the bites of snakes were reported to have occurred in the year 1869. The actual number of annual deaths from this cause, however, is estimated by Fayrer to be 20,000, consequently the annual rate of mortality from this cause, for every 10,000 inhabitants, is 1.6. Most of these cases are produced by the spectacled snake (cobra-de-capello) and the rock-snake (*bungarus cæruleus*), although a few deaths are caused by other varieties. The bite of a vigorous specimen of the above-mentioned families must inevitably result in death, if the poison be not in some way arrested by the clothing, or speedily withdrawn (by excision or cauterization).

Symptomatology.

The local and general symptoms resulting from the poisoning by a snake-bite are in all essential points similar to those following the bite of an adder. The most important constitutional symptoms are : a feeling of numbness, extreme restlessness, involuntary discharge of urine and fæces, dilated or contracted pupil, slow and irregular respiration, cramps, twitching of the muscles, suspension of reflex excitability, and anæsthesia of the skin, while consciousness and the mental faculties are retained until the last moment, paralysis and death supervening with or without cramps and convulsions. Death may ensue even within twenty minutes after the infliction of the bite, or may occur almost instantaneously if the poison is injected into a large vein. According to Jones, the temperature at the beginning is but slightly raised, and is afterwards lowered. The heart's action is accelerated, but weak. Passive hemorrhages frequently occur, particularly in the digestive canal, combined with general jaundice. Aphasia is not unfrequently noticed also among the first symptoms, and this sometimes continues after the disappearance of the other phenomena, originating possibly, as has been suggested by Ogle, in some central lesion.

At the autopsy no muscular rigidity is found; the right auriculo-ventricular cavity contains tarry, loosely coagulated blood, while the left cavity is empty. The vessels of the brain and its membranes are distended with dark-colored blood. The liver appears gorged with blood, swollen, and dark-colored. The lungs in like manner appear hyperæmic.

Treatment.

The most efficacious procedure that can be resorted to after the bite of a venomous snake is—to quote the advice of Fayrer—the following: The application of a ligature as tightly as possible around the bitten limb, above the seat of the wound, scarification and suction by means of the mouth or cupping-glass, and subsequently the application of the actual cautery, or cauterization with caustic potash or a mineral acid. If the limb swell after the application of the ligature, this must then be loosened, to be drawn tight again, however, whenever symptoms of general infection show themselves. If a finger or toe form the seat of the bite, it is then best to amputate the limb at the joint next above the wound. If the bite has been inflicted at a point which does not admit of the application of a ligature, the indication then is to promptly excise the injured tissue, together with the surrounding parts.

The patient should rest perfectly quiet. As soon as indications of poisoning are perceived, preparations of ammonia (liquor ammoniæ) are to be administered, or, what is still better, he should be made to drink copiously and frequently of spirituous liquors diluted with hot water, taking care, however, not to produce intoxication. Should symptoms of collapse supervene, sinapisms, galvanization of the heart and diaphragm, or cold douches may be resorted to.

In cases of poisoning by venomous snakes, especially the *cobra*, all the reputed antidotes to snake poison (ammonia, arsenic, liquor potassæ, carbolic acid) are ineffectual. Although from one to two drops of carbolic acid inserted within the mouth of the *cobra* suffices to destroy it within a few moments, it produces no neutralizing effect whatever upon the poison or the poisoned wound.

The method recommended by Halford is the following :—He injects thirty drops of water of ammonia (= gr. 0.95 ammonia) into a superficial vein, which is immediately followed by a brisk activity of the circulatory and nervous systems ; this procedure is repeated as soon as the stimulating influence of the remedy is suspended. As to the efficacy of this method, a contrariety of opinions prevails. While some affirm that they have applied it with favorable results, we are assured by trustworthy and experienced observers (Fayrer, Richards), that it is of no avail. In the case of rabbits that had been bitten by a rattlesnake, Stern tried a solution of the gall of a rattlesnake (one part to ten of alcohol) diluted with water, and with the best result.

Anderson administered successfully in one instance bromide of potassium combined with copious alcoholic stimulants.

DISEASES FROM MIGRATORY PARASITES.

HELLER

INTRODUCTION.

UNDER the head of "*Invasions-Krankheiten*"[1] I propose to describe such affections as "depend upon the penetration of animal parasites into the tissues." My reason for so naming them consists in the necessity of having at our command a short, expressive term, instead of an involved expression.

According to this plan, only a small number of parasites come up for consideration. Of the *Cestoda*, the *Echinococcus* and the *Cysticercus cellulosæ*, and of the Nematoda, the *Trichinæ* are here to be described.

The *Strongylus gigas* has perhaps never yet been observed in man, or at all events only in extremely rare cases. The *Filaria medinensis* is chiefly of surgical interest. The *Cysticercus acanthotrias* has been found only by Weinland,[2] and by him only once in fifteen cases; it occurred in a maiden lady, aged fifty, and was situated in the muscles and under the skin, one specimen lying loose on the inner surface of the dura mater. The *Cysticercus tenuicollis* has not yet, to a certainty, been observed in man. The newly discovered hæmatozoon—*Filaria sanguinis hominis*—which Lewis[3] believes is connected with chyluria, has not yet been sufficiently studied. May it not prove to be a young, freshly migrated specimen of Distomum hæmatobium?

Meschede's[4] report of a case of epileptic mental disturbance "occasioned by the eggs of another kind of tape-worm (Bothriocephalus latus) in the brain," is of no value without more accurate information as to whether or not this was the sole cause of the disease. A larval state of the Bothriocephalus latus is thus far entirely unknown.

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[1] "Diseases due to an invasion [of parasites]." The difficulty, if not impossibility, of translating this into an equally short and significant English expression has led me to employ the title placed at the head of this chapter—Diseases from Migratory Parasites. —TRANSLATOR.

[2] Verhandlungen der K. L. C. D. Akad., XXVIII. Band, 1861, S. A., p. 5.

[3] On a Hæmatozoon, inhabiting Human Blood, etc., by T. R. Lewis, M.D. Calcutta, 1872. (Deutsches Archiv f. klin. Med., XI., p. 540, 1873.)

[4] Tageblatt der Naturforscherversammlung in Leipzig, 1872, and Allgem. Zeitschrift f. Psychiatrie, XXX. p. 109, 1873.

The question, whether the Cysticercus of the Tænia mediocanellata (saginata) may occur in man, is not yet decided. As the experiment on man is not admissible, I fed an ape (*Macacus cynomolgus* of the East India islands), which was at my command, three times with three and a half, six, and four fresh joints respectively, each one containing a considerable number of eggs of the Tænia mediocanellata (saginata). After the unfortunate premature death of the animal, seven weeks after the first, and two weeks after the last feeding, no trace was found of these parasites, with which I had become familiar in Prof. Zenker's experiments on goats.[1] With the exception of one encapsulated strongylus found in the lung, the animal was entirely free from parasites. According to a verbal report by Prof. Völckers, Colberg declared a cysticercus extracted by the former from a man's eye to be in fact a Tænia mediocanellata, since the rostellum, the crown of hooks, and all indications of the earlier existence of such, were entirely absent.

The *Pentastomum denticulatum*, the undeveloped state of the Pentastomum tænioides, which is found in the frontal sinuses of the dog and wolf, and is frequently seen encapsulated and generally calcified in the liver, small intestine, stomach, lung, spleen, and kidneys (found alive in the liver by Wagner and in the lung by Zenker), when occurring singly causes no disturbance, but according to Leuckart's researches amongst animals, when in great numbers gives rise to enormous destruction of tissue.

ECHINOCOCCUS.

Chapter I.

Van Beneden, Zoologie médic., II., p. 275.—*Davaine*, Traité des Entozoaires. Paris, 1860, p. 350.—*Göze*, Versuch einer Naturgeschichte d. Eingeweidewürmer. Blankenburg, 1782, pp. 258, 284.—*Küchenmeister*, Die in und an d. Körper des lebend. Menschen vorkommenden Parasiten. Leipzig, 1855, I., p. 141.—*Leuckart*, D. menschlichen Parasiten, I., p. 342. Leipzig, 1863.—*Naunyn*, Archiv f. Anat., Physiolog., etc., 1862, p. 612.—*Pallas*, Neue nordische Beiträge, I., p. 83, 1781.—*v Siebold*, Zeitschr. f. wissenschaftl. Zoologie, IV., p. 409, 1852.—*Virchow*, Verhandlungen d. med.-phys. Gesellschaft zu Würzburg, IV., p. 84, 1855.—*G. Wagener*, Entwickelung der Cestoden. Breslau, 1854.—Chemische Untersuchungen des Echinococcus veröffentlichten: *Bödeker*, Zeitschr. f. ration. Med. Neue Folge, 7, p. 137, 1855.—*Heintz*, Jen. Annal. f. Phys. u. Med., I., p. 80, and Poggendorf's Annalen, 80, p. 114, 1850.—*Lücke*, Virchow's Archiv, 9, p. 189, 1860.—*Naunyn*, Archiv f. Anat., Phys., etc., 1863, p. 417.—*Sommerbrodt*, Virchow's Archiv, 36, p. 272, 1866.—*Wilde*, Deutsches Archiv f. klin. med., VIII., p. 116, 1870.

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[1] Sitzungsber. d. phys.-med. Soc. zu Erlangen, 1865–67, I., p. 15; IV., p. 71, 1872.

HISTORY.

Ever since the time of Hippocrates we find descriptions of many tumors which are undoubtedly to be considered as referring to the echinococcus. The echinococcus was, however, first recognized as a separate living creature by Pallas in 1766. In 1782 Pastor Göze discovered that the Scolices were tape-worm heads.

Küchenmeister, v. Siebold, and van Beneden, and, still later, Leuckart, have experimentally proved the relationship of the echinococcus to the tænia echinococcus of the dog (1852). Virchow showed the connection of the echinococcus multilocularis —previously described as colloid cancer—with the echinococcus.

In Hippocrates (Aphorism., Sect. VII., No. 55) we find the following: "Quibus hepar aqua plenum in omentum erupit, his venter aqua repletur et moriuntur."

Chapter II.

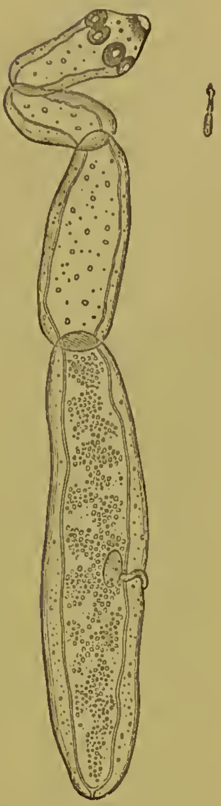
NATURAL HISTORY.

The echinococcus, or ensheathed worm, is the larval condition of the tænia echinococcus, a small tape-worm, about four millimetres in length, whose usual haunt is the upper part of the small intestine of dogs. The whole tape-worm consists of a head and three joints, or segments, the last of which is usually mature, and the time for its separation close at hand; this last joint exceeds in size the whole remaining portion of the worm. The very prominent rostellum of the head supports a crown containing from thirty to fifty rather blunt hooks, arranged in two rows.

The larva—the echinococcus—consists usually of a rounded sac, of exceedingly variable size (from that of a pin-head to that of a child's head), which is enclosed in a connective-tissue capsule, formed from the surrounding tissues, and is thus separated from them. This capsule is usually very firm, and is frail only in the brain. The wall of the echinococcus sac is itself either delicate, and of a dull, white color, or very substantial and translucent, of about the consistence of boiled white of egg, and divided into distinct lamellæ. It consists of a substance resembling chitine.[1] If a section of the sac be made, the cut edges will immediately coil around upon themselves.

The sac is filled with a clear, often yellowish, somewhat opalescent, neutral, or weakly alkaline fluid, having a specific gravity of from 1.007 to 1.015, which contains no albumen, or only a trace of it,[2] but is rich in chloride of sodium. Besides this, succinic acid,[3] either free or in the form of succinate of lime[4] or of soda,[5] inosite, grape-sugar, leucine, and several less important ingredients are found in small quantities; and in the liver—echinococcus, crystals of hæmatoidine.[6]

In rare cases the contents of the echinococcus vesicle are of a bloody color.



FIGS. 1, 2.

Tænia Echinococcus.

Fig. 1. [8]Natural size.
Fig. 2. Magnified (after Cobbold).

In four cases of echinococcus, Professor Jacobsen[7] found 0.55–0.61–0.71 and 0.84 per cent. of chloride of sodium. In two of these, from the liver, there was a considerable amount of leucine; in two others, from unspecified portions of the abdomen, none whatever; 0.07 per cent. of succinic acid in the two liver—echinococci, which was wanting in the two others; the grape sugar was absent in the latter, while the former yielded 0.096 and 0.006 per cent. of it. Albumen was found in none, although on evaporation one yielded the allied substance, caseine, in small quantity.

The inner surface of the echinococcus cyst is lined with a granular germinative or parenchymatous layer, which is furnished with small, rapidly vibrating cilia, on its inner surface.[1] This germinative layer becomes thickened in spots into little mounds, in each of which a vacuole-like cavity is formed ; upon the inner surface of these cavities—brood-capsules—the tapeworm heads—scolices—originate as conical-shaped projections, which communicate with the cavity of the echinococcus cyst ; the double row of hooks and the suckers are formed on the free extremity which projects into the main cavity. The brood capsules, as also the cone-shaped heads, are endowed with the capability of lively contractions. The base of this head afterwards contracts itself posteriorly to a thin pedicle, which finally separates entirely from the wall of the brood capsule, so that the heads

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[1] Lücke, l. c.

[2] *Naunyn*, *Heintz*, l. c.—*Rosenstein* and *Sänger*, Berl. klinische Wochenschrift, 1873, No. 20.

[3] *V. Recklinghausen*, Virchow's Archiv, 14, p. 481.

[4] *Heintz*, *Bödeker*, l. c.

[5] *Naunyn*, *Bödeker*, l. c.

[6] *Davaine*, l. c., p. 373.—*Habran*, Thèse de Paris, 1869. Jahresber., 1869, I., p. 5.

[7] These analyses, thus kindly furnished me, will be more fully reported elsewhere.

[8] With the exception of Fig. 2, all the wood-cuts illustrating echinococcus have been engraved with great care by Mr. Flegel from drawings which I made from nature.

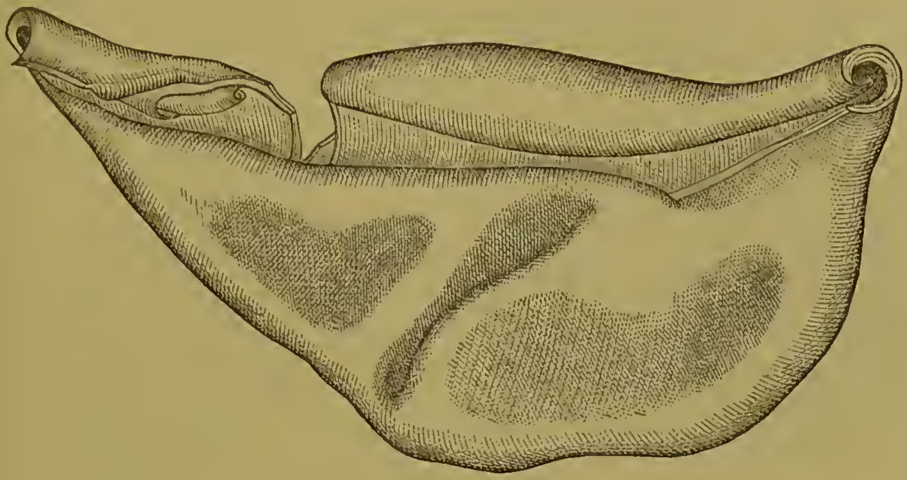

FIG. 3.
Incised Echinococcus Membrane from the Kidney. From the Kiel Collection.

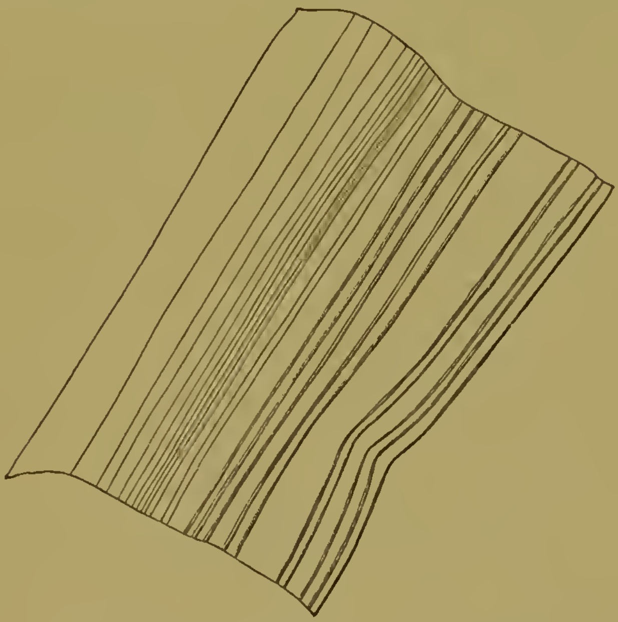

FIG. 4.
Transverse Section of Echinococcus Membrane. (Magnified.)

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[1] *Naunyn*, l. c., 1862, p. 615.

move about freely within the vesicle. In this manner several (as many as nine, or even more) scolices originate in every brood capsule. So long as the pedicle has not yet become detached, the heads may turn themselves as it were inside out, and appear on the outside of the brood capsule. The free heads in the capsule are generally spherical, because they retract the anterior portion, together with the circlet of hooks and the suckers, into the dilated hinder part. At death they are usually everted, and then present their conical form. Scattered throughout the parenchyma of the heads are more or less numerous calcareous bodies, with concentric laminæ.

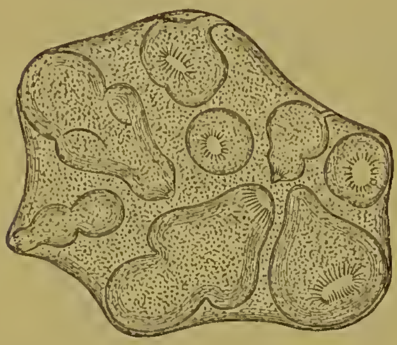


Fig. 5.

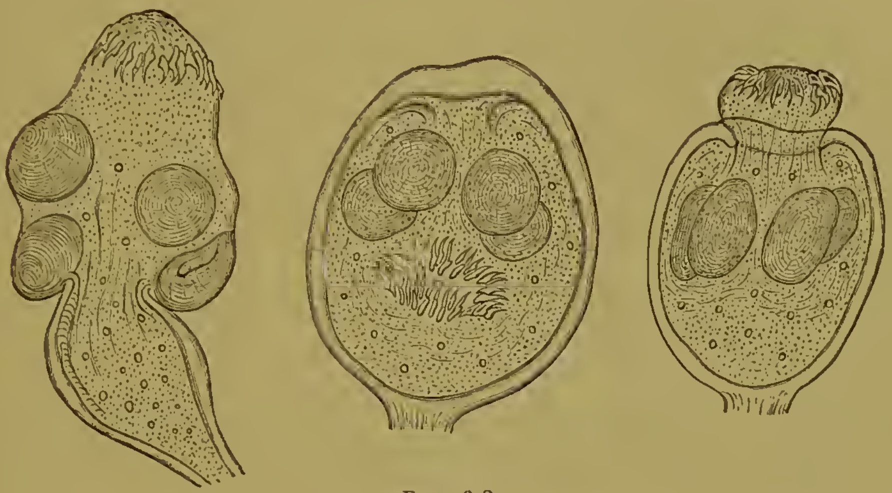
Brood Capsule, with Scolices, partly free, and partly still adherent. (Magnified.)

This process of proliferation usually occurs after the echinococcus sac has attained a considerable size; in many cases, however, the increase in size does not result in the evolution of scolices; the cyst frequently attains an immense size without proliferation.

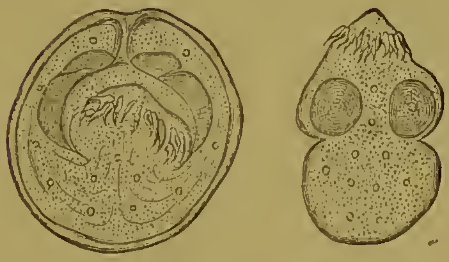
In man the development of brood capsules and scolices but rarely takes place directly from the primary echinococcus vesicle. Much more frequently one or more generations of daughter vesicles are produced, from which the development of brood-capsules and scolices may continue in the manner above described. In that case, more or less numerous daughter vesicles are found in the mother sac, a single one, or even all of which may have grandchild vesicles encased within them. These secondary or daughter vesicles grow out either from the brood-capsules or from the scolices, or directly from the germinal layer. They develop either from the inner side, within the mother sac—*endogenously*—or upon the outer side—*exogenously*. The latter mode is the more common in the lower animals, and the former in man. The daughter vesicles may be few in number, or they may amount to several thousands; the size is variable; under different circumstances they are found varying from scarcely the size of a pin-head to that of a hen's egg; they are very seldom any larger.

The echinococcus is endowed only to a slight degree with the power of independent motion.[1]

The route by which the echinococcus embryo migrates from the gut into the organism is not yet positively determined. The preponderating frequency of its appearance in the liver forces us to the conclusion that its regular path is either through the bile-ducts or by way of the portal vein; Schröder van der Kolk[2] pointed out the former by his injections, as did Friedreich[3] in



Figs. 6–8.
Echinococcus Scolices attached to the Brood Capsule.
Protruded. Retracted. Partially protruded.



Figs. 9 and 10.
Free Echinococcus Scolices.
Retracted. Protruded.

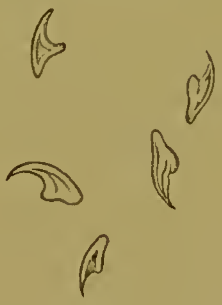


Fig. 11.
Echinococcus Hooklets.

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[1] *Küchenmeister*, l. c., p. 155.— *Wagener*, l. c.

[2] Cited by *Virchow*. Würzburger Verhandlungen, VI., p. 93, 1856 (*Ruyssenaers*, de nephritidis et lithogenesis quibusdam momentis. Dissert. inaug. Traj. ad Rhen., 1844, p 49).

[3] *Friedreich*. Virchow's Archiv, 33, p. 32.

multilocular echinococci. Its presence in other organs would render probable the supposition that it had been carried by the portal vein. Leuckart,[1] in his feeding experiments, was unable to settle this question.

Küchenmeister (l. c.) distinguishes two varieties of echinococcus, according as the scolices develop directly from the mother sac, or several generations of daughter vesicles are previously interposed; he calls the former *echinococcus scoliciparіens*, and the latter *echinococcus altriciparіens;* the former have from twenty-eight to thirty-six hooklets in their crowns, the latter from forty-six to fifty-two. The hooks of these latter are much smaller. Küchenmeister believes that the tænia of the echinococcus altriciparіens is present in the small intestine of man, as in that of the carnivorous domestic mammals, the dog and the cat.

This view is rejected by the majority of helminthologists, and, on the contrary, the two forms of echinococcus are held to be identical.

Whether, as Küchenmeister supposes, the tænia echinococcus really does appear in the intestine of man, and there give rise to self-infection, still remains undecided. The most minute inspection of the small intestine in fresh cases of echinococcus, especially in such cases as those in which scolices had probably been swallowed during life, is extremely desirable.

No one has yet succeeded in producing the tænia echinococcus in dogs by feeding them with the echinococcus originating in man.

The so-called *hydatid purring* is a peculiar symptom, and of considerable diagnostic value.

If we grasp an echinococcus tumor with one hand, at the same time exercising slight compression on it, on short quick percussion a feeling of vibratory motion will be experienced.

This sensation may be illustrated by lightly touching a base cord of a piano with one finger, and then gently striking the corresponding key, or by resting three fingers loosely on the spiral spring of a sofa, and then tapping with the middle one.

According to Briançon,[2] the discoverer of this symptom, it is most distinct when the mother sac contains numerous daughter vesicles with but little fluid between; with the decrease in number of the daughter vesicles, and the increase of fluid, the hydatid purring loses its distinctness; cysts without daughter vesicles do not give rise to this phenomenon.

As a rule, the echinococcus grows very slowly, and seems to retain life very long. The products of proliferation often present a good and healthy appearance after decades; more frequently, however, in the course of a year changes occur which cause their death or that of the animal.

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[1] *Leuckart*, l. c., I., p. 372.

[2] *Briançon*, Essai sur le diagnostic et le traitement des acephalocystes. Thèse de Paris, 1828, I., p. 18.

The membrane, then, in the beginning seems cloudy, although still distended; subsequently the fluid contents gradually vanish, and the vesicle may completely collapse. It then lies folded in the cavity formed by the connective-tissue cyst. A deposit of fat and of lime salts soon takes place in and upon it, sometimes in great abundance, yet the membrane itself withstands complete destruction for a long time. The daughter sacs succumb to a similar alteration, but their walls perish much earlier than those of the primary sac. The scolices die early, lose their hooks, and either go to ruin entirely, or, being impregnated with lime, form a sediment in what little fluid may still remain. After a still further retrogression in the shrivelled and hardened cyst contents, which are also in a condition of fatty degeneration and calcareous infiltration, either single hooklets, or crowns of hooks, or whole scolices are found calcified, besides crystals of cholesterine, often in great quantities, and hæmatoidine in liver echinococci. Usually, while the echinococcus is undergoing these changes, the connective-tissue capsule also shrivels; its walls thicken and are meantime impregnated with lime salts. The whole echinococcus may finally be converted into a single lime concretion of greater or lesser size.

FIGS. 12–14.
Dead Calcified Scolices.

12. Retracted.
13. Well preserved.
14. Broken.

The term "*Hydatids*," which is still often employed, should be entirely dropped, so far as regards the echinococci, since it is lacking in accuracy of description, and frequently serves only as a mantle for ignorance.

"*Acephalocysts*" is the name given since the time of Laennec to such echinococcus tumors as contain no scolices. There was formerly a disposition not to recognize them as echinococci; they are, however, to be considered as imperfectly developed echinococci, incapable of proliferation, owing perhaps to their having been blighted in their earlier stages of development by some external influences. Frequently in the same echinococcus, daughter vesicles of corresponding size are found, some with, and others without, echinococcus scolices. Thus, in the case of a cow, whose lungs and liver were thickly set with innumerable echinococcus sacs, I was able to find scolices in but very few. These were chiefly to be distinguished from the others by a greater thickness of the walls.

The *echinococcus multilocularis*[1] is a peculiar developmental form of the echinococcus. This growth bears a certain resemblance to colloid cancer, and was classed as such by the earlier observers; Virchow[2] first recognized its true nature. Up to the present time it has (with the exception of one case of its occurrence in the suprarenal capsule) been observed only in the liver. (Vide infra).

The echinococcus multilocularis forms a firm tumor, of greater or lesser magnitude, almost as hard as stone, which takes the place of a corresponding portion of the liver substance. It sometimes increases to remarkable dimensions; in Griesinger's case it occupied the whole anterior part of the abdomen; in a case reported by Huber it was of the size of a child's head. When the multilocular echinococcus arrives at the surface of the liver, its (the liver's) capsule becomes immensely thickened and firmly united to the neighboring structures, and is traversed, particularly in the vicinity of the tumor, by fine yellowish stripes. On section, the mass is found to consist of very dense fibrous tissue, and ramifying through it are numerous large and small cavities branching and communicating with each other; some of these cavities are loosely, and others firmly, filled with a sticky, gelatinous substance, in which are found here and there rounded and angular smaller cavities. Microscopically examined, these smaller cavities show essentially the characteristic structure of echinococcus membranes, with, of course, some variations: they but seldom prove to be vesicles; well-preserved scolices are very rarely found; in many cases they are entirely overlooked, or are discovered only by isolated hooklets. Crystals of hæmatoidine are frequently seen. The fibrous tissue is more or less icterous. The multilocular echinococcus shows a strong tendency to ulcerative destruction; we often find toward the centre of the mass (seldom more toward the periphery) one or more abscesses, with irregularly cut walls, and crumbling, markedly icterous, and sometimes dark-green contents.

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[1] *Griesinger*, Archiv d. Heilkunde, I, p. 547, 1860.

[2] *Virchow*, Verhandlungen der phys.-med. Gesellschaft zu Würzburg. VI., p. 84, 1856, and Virchow's Archiv, XI., p. 80.—*Huber*, Deutsches Archiv. f. klin. Med., I. p. 539, 1865; IV., p. 613; V., p. 139, and Virch. Arch., 54, p. 269, 1872. Jahresbericht des naturhistor. Vereins zu Augsburg, 1861.—*Kappeler*, Archiv d. Heilkunde. 1869. p. 400. (Two cases).—*Heschl* (?), Oester. Zeitschr. f. prakt. Heilkunde, VII., 5. 1861. —*Prougeansky*, Dissert. Zürich, 1873 (Five cases.) The remaining literature may be found in *Klebs*, Handbuch der pathol. Anatomie, II. Lieferung, p 517.

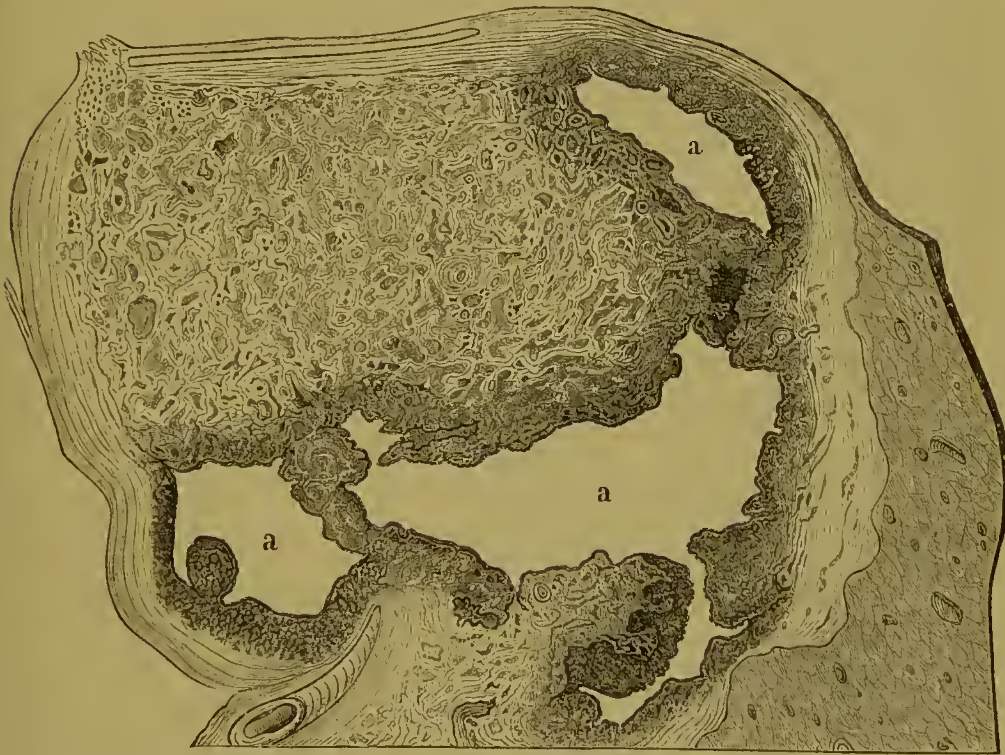

FIG. 15.

Echinococcus multilocularis. The section shows several cavities (*a*) of irregular, bay-like outlines, markedly icterous at their borders.
(From a preparation in the pathological collection at Erlangen.)

According to Virchow and Klebs, the development of echinococcus multilocularis takes place in the lymph-vessels; according to Friedreich,[1] in the blood-vessels and gall-ducts.

Virchow discovered on the surface of the liver, as well as on all parts of Glisson's capsule in the liver, and also along the bile-ducts, as they emerge from the hepatic substance, thick, nodular, gelatinous cords, which he could only explain as lymph-vessels filled with echinococci.

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[1] *Friedreich*, Virch. Archiv, 33, p. 16, 1862.

In a hitherto unpublished case of Prof. Zenker's, a multilocular echinococcus nodule, somewhat larger than a pigeon's egg, encircled the ductus choledochus; the section made through the tumor presented the appearance shown in Fig. 15.

In one of Prof. Jürgensen's unpublished cases, a large cavity was found in the centre, filled with a fluid which presented the characteristic chemical reactions of echinococcus fluid.

In four cases, the multilocular echinococcus has been found in other situations than those already mentioned; in two cases in the lung,[1] in the subperitoneal tissue of the uterus,[2] and in the intestinal wall.[3] Huber questions the genuineness of one of the lung cases

Besides being met with in man, the echinococcus is found in its larval state in the ape, cow, sheep, goat, camel, dromedary, chamois, antelope, deer, giraffe, horse, ass, zebra, and hog; also in the squirrel, kangaroo, and other feline animals.[4] Von Siebold found one in a turkey; but with this exception, it has not been noticed in birds. In the future it will probably be discovered in other ruminants.

The echinococcus of the ape, horse, camel, and dromedary, like that of man, develops secondary or daughter vesicles endogenously.

The *geographical distribution* of the echinococcus corresponds with that of the dog, as this animal seems to be the especial "host" of the tænia echinococcus; it has probably extended over the whole earth; on this point, however, we have not yet sufficient information.

In Europe it has been observed everywhere; in America, it seems, but seldom; of its presence in Africa, our sole information thus far is derived from Bilharz, who reports it in Egypt. Even Australia is not free[5] from it. The echinococcus is almost incredibly frequent in Iceland, where the dog plays such an important rôle in the life of the inhabitants. In Iceland every peasant owns, on an average, six dogs, which share his dwelling with him. According to Thorstensen, every seventh person in Iceland harbors the echinococcus, and in some districts even every third person.

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[1] *Féréol*, L'Union méd., 1867, No. 114.—*Scheuthauer*, Oesterr. med. Jahrbücher, 14, p. 17.

[2] *Scheuthauer*, l. c.

[3] *Heschl*, l. c., and *Böttcher*, Virch. Archiv, p. 15, 1858.

[4] *Cobbold*, l. c., p. 261.—*Davaine*, l. c., p. 617.

[5] *Cutts*, Melbourne Med. Rec., 1862 (Schmidt's Jahrbücher, 116, p. 183, 1862).—*Richardson*, Edinburgh Med. Journal, 1867, p. 525.

With the exception of a single case in Dorpat, the multilocular echinococcus has been found only in Southern Germany and in Switzerland.

According to a verbal report of Prof. Bartels, there was a case of multilocular echinococcus under treatment in the hospital here last year.

The author saw two livers in the museums in London and Edinburgh, which, as far as was possible without an examination, he considered as cases of multilocular echinococcus, and to which he called the attention of Drs. Cobbold and Turner.

Chapter III.

PATHOLOGY.

Section I.

GENERAL PATHOLOGY OF THE ECHINOCOCCUS.

The echinococcus occurs in both sexes, and at all ages, yet very seldom in infancy, and most frequently in middle age.

Cruveilhier's[1] case in a child twelve days old may well be considered as something else, especially as no sac was found in the liver cyst, which had fibrous, cartilaginous, and bony walls, and which communicated with the ascending colon; if it really was a case of echinococcus, the embryo must have migrated in the earliest period of fœtal life.

The echinococcus appears in all the organs of the human body, but most frequently in the liver; in fact, oftener there than in all the other organs together. It occurs not infrequently in the lung, spleen, kidney, and omentum; seldom in the brain, vertebral canal, eye, heart, testicle, vesiculæ seminales, ovary, uterus, breasts, pancreas, and processus vermiformis; somewhat more frequently again in the subcutaneous tissue of the trunk and in the bones. Usually only one echinococcus is found in the individual, but sometimes several (as many as twelve) are present, either in the same organ or in different ones.

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[1] *Cruveilhier*, Traité d'anat. pathol., XXXVII., pl. 4, Text, p. 6.

Davaine (l. c., p. 376) has collected a large series of cases; of 383 cases, 166 occurred in the liver alone; yet Davaine observes that he selects only such cases of liver echinococcus as possess a peculiar interest, while he gives the fullest possible collection of those found in other organs. Some of the cases are doubtful, so that several, especially of those in the brain and spinal marrow, may be believed to have been cysticerci.

In the kidneys there were 30, 16 of which were in the calices; 2 were in the testicles and scrotum; (?) 1 each in the suprarenal capsule, vesiculæ seminales, uterus, placenta; (?) 4 (?) in the ovary, 6 in the hip, = 16; in all, in and on the abdomen, 238 cases. Lungs 40, heart 10, brain 20, (?) spinal cord 10, bones 17; 2 each in the pulmonary artery and vein, pituitary gland, face, mouth, thyroid gland, upper part of arm; 3 were found in the eyeball, 5 on the neck, 9 (?) in the orbital cavity, 7 in the mamma, 12 in the anterior thoracic and abdominal wall.

Amongst 4,760 dissections made in the course of ten years at the Berlin Pathological Institute, the echinococcus [1] was found 33 times:

19 times in 3,042 males.
14 times in 1,718 females.

Of these, 27 occurred in the liver alone, or in the liver and other organs together: one opened externally, and four through the diaphragm; the echinococcus was found four times in the spleen, three times in the lungs, twice each in the pleura, omentum, and kidney, once each in the ligamentum latum and the heart, and five times in the intestinal walls.

Not one of these individuals was under ten or above seventy years of age. The majority were between twenty and forty years old.

In addition to the situations already named, the echinococcus has been observed in the pancreas,[2] in the psoas muscle,[3] and free in the abdomen;[4] in the latter case, it lay alongside a liver echinococcus, and may, therefore, have previously escaped from the liver; it has been noticed, too, in the processus vermiformis,[5] once with a liver echinococcus, and once, as observed by Birch-Hirschfeld,[6] lying free and alone in the dilated cavity of the processus vermiformis, the communication of which with the cæcum was obliterated for the distance of one-fourth of an inch. The atrophied mucous membrane presented mosaic-like impressions, caused by the pressure of the countless vesicles, which varied in size from that of a pin's head to that of a pea.

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[1] *Böcker*, Dissert. inaug. Berlin, 1868.
[2] *Seidel*, Jena. Zeitschr. f. Med., etc., 1864, p. 289, fourth case.
[3] *Cailleux*, Gaz. des Hôp., 1862, No. 92 (Jahresbericht, 1868, II., p. 394).
[4] *Emmert*, Würtemb. Correspondenzblatt, 1871, 4 (Jahresbericht, 1871, II., p. 166).
[5] *Scholler*, Preuss. militärärztl. Ztg., 1862, 2.
[6] *Birch-Hirschfeld*, Archiv d. Heilkunde, 1870, p. 191.

Thus far no phenomena have been recognized which may be attributed to the migration of the embryos through the tissues; but since the number of penetrating embryos must be exceedingly limited, they are scarcely to be expected.

Leuckart, too, as it seems, in his experiments with the echinococcus on hogs, was unable to discover any disturbances.

The migration of numerous cysticercus embryos produces marked symptoms in animals (Zenker,[1] Leuckart,[2] Mosler).[3]

The influence of the echinococcus on the tissues and organs in which it develops is varied; the latter may remain a long time without any considerable alteration, accommodating themselves to its slow growth; while, in other instances, they soon undergo atrophy. Those parts which are not in the immediate vicinity of the echinococcus generally present no changes, whilst those lying nearest to it suffer a more or less decided compression from the slow but constantly increasing growth of the parasite; should even a large part of an organ be destroyed in this manner, compensatory hypertrophy of the remaining portion may take place.

The right hepatic lobe of a girl, on whom Prof. Bartels had operated successfully four years previously, after an echinococcus had probably penetrated into the pleural cavity, was found extremely diminished in size, and its surface united to a moderate extent with the diaphragm and the base of the lung by coarse cicatricial bands, through which were scattered small chalky concretions; by means of these bands, moreover, the continuity of the diaphragm was destroyed, and behind them was a fistulous opening in the thoracic wall—the result of the operation—surrounded by firm, callous tissue. The left lobe of the liver was very much enlarged, and occupied almost the whole space that the right normally did.

Neighboring organs are often displaced by the advancing growth of the parasite; the various results of such dislocations are the same as when produced by other tumors. The circulation may be impeded, or even stopped, by compression of the hollow structures; hindrances to the passage of blood and lymph, prevention of the discharge of bile or urine, obstacles to the evacuation of the intestine, even difficulties in labor, may occur as results. It is proportionately harmless in the cellular tissue and the muscles. Absorption of bone may take place from the pressure of echinococci.

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[1] *Zenker*, Sitzungsberichte d. phys-medic. Societät, 1865–67, I., p. 15.

[2] *Leuckart*, I., pp. 296, 407, and 747.

[3] *Mosler*, Helmintholog. Versuche, 1864.

Chronic inflammatory action usually takes place in the neighborhood of the echinococcus, and tends to thicken the cyst-wall. The presence of the parasite not unfrequently, however, occasions acute inflammatory symptoms in the organ concerned, particularly if an injury from external causes be superadded; the result of this may be the formation of an abscess, with consequent pyæmia; the multilocular form seems particularly prone to ulcerative destruction.

Frequently such complete destruction of the adjacent parts takes place, owing to the mere pressure of the advancing growth, that an opening occurs either externally or into one of the neighboring cavities. This may also happen as the result of injuries, such as kicks, blows, or falls.

The contents of the echinococcus may be discharged into the air-passages, the intestinal canal, the uterus or the vagina, the biliary ducts or the ureters, the pleural or the peritoneal cavity, or the circulatory apparatus. The consequences naturally differ widely. Among the most favorable is rupture through the skin, and, next to that, discharge into the intestinal canal, ureter, gall-duct, or vagina. A spontaneous cure frequently occurs in such cases. A discharge through the air-passages is less promising, although this not infrequently results in a cure. An opening into the serous cavities of the abdomen and chest is, as a rule, followed by fatal inflammation, especially when accompanied by some sudden mechanical violence.

A perforation into the venous system, or into the right heart, results either immediately, or very soon, in death from embolism of the pulmonary artery; rupture into the left heart. or into the arterial vascular system, is followed by embolism and its sequelæ.

The development and growth of the echinococcus are very slow; consequently it causes early death only when situated in a vital organ. As a rule, the duration is several years; occasionally several decades. In one case, six months after the appearance of the first symptoms, an echinococcus found in a girl's axilla had only attained the size of a small nut.[1] In one of the two cases of echinococcus found on the inner surface of the dura mater,[2] the disease, from the beginning of the first symptoms until death, lasted seven and a half months; in this case, the larger of the two parasites found had not grown to so great a size as the one in the axilla, yet here it must probably have made its presence known much earlier than in the loose tissue of the axillary region.

According to a collection of twenty-four cases, of which Barrier[3] obtained sufficient data in regard to the duration, from the first symptoms on, it was less than two years in three cases, four years in eight, six years in four, and eight years in five; in the remaining four cases, it was fifteen years in one, eighteen years in another, more than twenty years in the third, and more than thirty years in the last. In still another case,[4] the echinococcus remained in the liver fifty-five years.

Very frequently the presence of the echinococcus has no effect whatever, the "bearer" dying of quite a different disease. In many other cases, of course, it causes early death.

The *symptoms* indicating the presence of the echinococcus are naturally manifold. In itself, it causes no severe illness; it becomes dangerous only under certain accompanying circumstances, especially those referable to its size. Generally, on account of its gradual increase, it is tolerably late before it occasions any perceptible disturbance. On post-mortem examination, well preserved and also dead echinococci of very considerable size are often found, without the slightest symptoms having been manifested during life, which could be attributed to their presence. Only when it has reached a certain size, as compared with the surrounding parts, does it become noticeable, especially so when, by its pressure on blood-vessels, urinary passages, the biliary ducts, or the intestinal canal, it impedes or prevents the normal evacuations.

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[1] *Velpeau*, Gaz. des hôp., 1857, p. 396 (cited by *Davaine*, p. 544).

[2] *Bartels*, Deutsches Archiv f. klin. Med., V., p. 108.

[3] *Barrier*, Thèse de Paris, 1840 (cited by *Davaine*, p. 383).

[4] Edinb. Med. Journ., 1835, p. 286.

When, however, the echinococcus has its seat in a vital organ, one which cannot be displaced, or its functions delegated to another, we often see dangerous symptoms setting in from the very beginning, or an early death takes place, even before the parasite has attained any considerable size.

Sometimes, in the absence of any very important damage to an organ, a kind of cachexia seems to come on; the patient wastes away, loses strength, and dies with fever, diarrhœa, and colliquative sweats.

In itself the echinococcus is not painful, only creating by its size an uncomfortable and troublesome sensation of fulness and weight. But, should inflammatory action be set up in the neighborhood, or should it result in abscess, severe pain, fever, and chills may ensue.

Diagnosis.

The diagnosis of an echinococcus is at first very difficult or impossible; only on further growth do symptoms manifest themselves which sometimes render a diagnosis possible. Only the sight of echinococcus membranes or shreds of membranes, of scolices or echinococcus hooks, gives a positive diagnosis, and these may be spontaneously discharged externally, or be obtained by operative means. A diagnosis may, however, be formed with approximative certainty by the coincidence of different conditions. Should a tumor develop slowly and gradually to a considerable size, without pain and fever, without symptoms of nutritive disturbances, or cachexia; should the tumor be of a regular rounded form, elastic, and show fluctuation, the development of echinococcus must be kept in view. If, on percussion, the hydatid purring should be distinct, the diagnosis is rendered almost positive; the absence of this symptom does not by any means prove the non-existence of the parasite. Absence of pain and fever excludes abscess; absence of pulsation, aneurism; the presence of this latter symptom is no evidence of the absence of echinococcus, as the pulsation may be transmitted from a large adjacent arterial trunk.

The diagnosis may be well supported, or positively established, by an exploratory puncture.

The echinococcus fluid is free from albumen, and presents the above-mentioned chemical constituents; a large quantity of chloride of sodium is its special characteristic. Dropsical ovaries and large hydronephroses may occasion some confusion; other fluctuating tumors of the abdomen are too infrequent, and scarcely ever attain a sufficient magnitude. The former have frequently been confounded with it, and the mistake only discovered by means of an operation.[1] The absence of albumen in the echinococcus fluid is sufficient to distinguish it from the contents of ovarian cysts, which are rich in albumen. A previous exploratory aspiration with a fine trocar should therefore never be omitted.[2]

Its differentiation from large hydronephroses is perhaps more difficult. The latter, besides the urinary salts, seem to contain chiefly albumen in considerable quantity. The urine salts are of no assistance in diagnosis, as they are also present in the kidney echinococcus.[3]

The chemical examination of the fluid of ovarian cysts, as also of the contents of hydronephroses, still leaves a large field open for investigation. In one case of hydronephrosis,[4] besides an abundance of urine salts and 7.5 parts in a thousand of other urinary substances, there was a considerable quantity of albumen, together with an abundant sediment of oxalate of lime in the form of octahedral crystals.

Unfortunately we still lack anything like a large number of analyses of echinococcus fluid from different organs, by means of which we might point out with certainty the anatomical location of the parasite. It cannot yet be positively stated whether or not its chemical constitution differs according to the organs in which it is situated. Thus, in the two above-reported analyses by Jacobsen (p. 558) succinic acid and grape-sugar were not discovered, whilst they were present in the liver echinococci; Wilde found both substances in a case of echinococcus of the spleen; Naunyn (l. c.), succinic acid in the liver and lung echinococci of the sheep.

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[1] *Spiegelberg*, Archiv f. Gynaekologie, I., p. 146.—*Smith*, British Med. Journ., 1868 (Jahresber., 1868, II., p. 594).—*Scherenberg*, Virch. Arch., 46, p. 392, 1869.—*Péan*, L'Union Méd., 1867, Nos. 141 and 142.—Compt. rend., 65, No. 24.

[2] See *Waldeyer*, Archiv f. Gynaekol., I., p. 252, 1870.

[3] *Davaine*, l. c., p. 374. (*Barker*, on Cystic Entozoa in the Human Kidney. London, 1856, p. 9).

[4] *Heller*, Deutsches Archiv f. klin. Med., V., p. 267, 1869.

The chemical examination of the fluid obtained by repeated punctures is not of value in forming a diagnosis; the albumen which it then contains is probably due to transudation from the blood or other fluids.

The microscopic discovery of scolices, rows of hooks, or single hooklets, in the sediment, establishes the diagnosis; but their absence does not disprove the existence of echinococcus.

The occurrence of severely itching urticaria is said to indicate that the echinococcus fluid has escaped into the abdominal cavity.[1]

Prognosis.

Infection with the echinococcus is not of itself a dangerous disease, and only becomes so under certain circumstances. The prognosis varies exceedingly, according to the situation and size of the parasite; in our consideration of it in individual organs we shall revert to this point.

Very large echinococci, or those still increasing in size, are always to be regarded with anxiety; the prognosis is less favorable when local or general disturbances supervene, either in consequence of other diseases, especially chronic forms, accompanied by exudation, or as the direct result of the parasite.

Pregnancy does not tend to make the prognosis any more unfavorable; on the contrary, an entire subsidence of a liver echinococcus has been observed under its influence.[2] In another case, however, a sudden increase took place during pregnancy, and the echinococcus was afterwards removed by an operation.[3]

Treatment.

Medicinal treatment of echinococcus does not promise much. Only remedies which are soluble and easily absorbed by the blood, and which can, therefore, be carried to the parasite, and permeate its capsule by endosmosis, need be considered; they must also be administered in sufficient quantity to be poisonous to the parasite, without exercising any injurious effects upon the patient's system.

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[1] *Jonassen*, Ugerkrift for Laeger, 3 R. XIII., No. 25.

[2] *Seidel*, Jen. Zeitschrift f. Med., etc., 1864, p. 289.

[3] *Hofmokl*, Wiener med. Presse, 1868, No. 40.

Of the many remedies recommended, we shall mention only the salts of mercury[1] and the iodide of potassium, the results from which in some cases have been much lauded, but in others found wanting.

Heckford[2] saw an echinococcus of the left lobe of the liver in a woman, twenty-two years of age, disappear in five weeks under the use of twenty-seven grains of iodide of potassium daily.

In the case of a boy, Reeb[3] saw the symptoms of an echinococcus tumor of the brain disappear twice under the influence of large doses of iodide of potassium (from two to fifteen grains daily), blindness alone remaining; on a third occasion this treatment accomplished nothing.

Hjaltelin[4] has lately recommended, in cases of growing liver echinococcus of recent formation, the tincture of kameela, in doses of from thirty to forty drops three times a day, in a tablespoonful of water; this treatment to be continued from four to six weeks. Hjaltelin claims that in this manner he caused the disappearance of the echinococcus in twenty-two persons.

Electricity is recommended from different quarters, and its results lauded.[5] H. Fagge[6] thrusts two gilded steel needles into the tumor, two inches apart, and connects both with the positive pole; he places the negative pole of a constant current from ten elements between the needles, and allows the current to pass for twenty-five minutes. Forster does the same. Only a few drops, if any, of the fluid escape by the side of the needles.

The most favorable results in cases of echinococcus have been attained by surgical means, where the parasite was accessible to surgical treatment. Those lying in external parts are simply opened by a single incision, and emptied, and the treatment carried out according to the rules of surgery. For the cure of echinococcus of internal organs there is a variety of methods in use, with innumerable variations and modifications of detail, which are all more or less worthy of recommendation, and all of which have produced good results.[1] Their object is, substantially, the prevention of the escape of the fluid into the serous cavities, by obtaining a previous adhesion of the two surfaces.

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[1] *Davaine*, l. c.

[2] *Heckford*, British Med. Jour., 1868.

[3] Cit. Jahresbericht, 1871, II., p. 70.

[4] Edinb. Med. Jour., XIII., p. 137, 1867.

[5] *Davaine*, l. c., p. 565.

[6] *H. Fagge*, Lancet, 1868, p. 75.

A single puncture[2] with a fine trocar, and the withdrawal of a portion of the fluid, seems to be sufficient in many cases. After the puncture, the patient is ordered to lie upon his back for two days; the wound is closed with collodion; exudation into the sac, death of the animal, and resorption follow. Should suppuration of the sac occur, the formation of a larger aperture would be rendered necessary, together with frequent injections of a solution of carbolic acid.

Of forty-six cases treated in the English hospitals by puncture alone, complete recovery followed in thirty-six; in ten suppuration took place, and incision became necessary, followed by death in two cases. The puncture should be made as soon as the echinococcus has attained a sufficient size to determine positively the nature of the cyst, provided it is still increasing in size. Only a portion of the fluid should be allowed to escape, that the entrance of air may be prevented.

Simon[3] practises and recommends double puncture, with subsequent incision. The tumor is punctured with a fine trocar, and the canula allowed to remain; in twenty-four hours peritoneal union will have taken place. Eight days afterwards a second trocar is thrust in at some distance from the former, and the canula again allowed to remain. After about twenty-four hours the two punctured wounds may be united by an incision. After the sac has been emptied, it is washed clean by tepid injections; should the secretion have a bad odor, disinfecting solutions of iodine, carbolic acid, hyposulphite of soda, and the like, should be employed. Fiedler[4] recommends that the trocar should be thrust in obliquely, in order to prevent the sac from gliding away from the canula; and for the same reason he considers it advisable to allow only a portion of the fluid to escape.[1] Fiedler anæsthetizes the skin between the two punctures, before it is cut, with spray, according to Richardson's method.

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[1] *Davaine*, op. cit., 565 et seq., gives a very full account.

[2] *Murchison*, Lancet, 1868, p. 75.—*Anstie*, Lancet, 1870.

[3] *Simon*, Deutsche Klinik, 1866, pp. 388 and 404.

[4] *Fiedler*, Deutsches Archiv f. klin. Med., VI., p. 607, 1869.

According to Récamier's method,[2] the echinococcus tumor is opened by cauterization; by its gradual operation a union of the serous membranes is effected before the opening takes place; this method is exceedingly painful and tedious

In a case reported by Bouchut, Gaz. de Paris, 1865, the time occupied in the application of the cautery, previous to the opening, was twenty-one days.

Trousseau aims at union by thrusting in numerous needles, yet this very frequently fails.

Fiedler used four long Carlsbad needles, and Mireur (Thèse de Paris, 1868), from forty to sixty, without obtaining adhesion.

With the immense amount of material afforded by Iceland, it is to be regretted that Finsen and Hjaltelin, the two Icelandic physicians who have had charge of the greatest number of cases, should be engaged in fruitless disputes, as to whether cauterization or puncture and incision should be given the preference, instead of attempting the solution of more important questions. The particulars of the numerous publications on this subject may be found in Virchow, Hirsch, and Gurlt's Jahresberichten.

Simon's method, with Fiedler's modification, or Finsen's proposed improvement, would seem to be the most worthy of commendation. The puncture should be performed with a curved trocar, in order that the second may be made from within outwards with the same instrument. At all events, the danger of tearing away the sac from the adhesions around the first puncture is thus avoided, and a better prospect of a good result obtained.

Subsequent injections are necessary for the promotion of healing and the prevention of suppuration. Gall is used by many, and it deserves further trials.

Far more difficult than the choice of the method, is the decision whether, and at what time, an operative procedure of any sort should be undertaken. In echinococci which show no tendency to increase, and which create no excessive disturbances, one would scarcely resort to an operation.

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[1] *Wilde*, Deutsches Archiv f. klin. Med., VIII., p. 116, 1870.

[2] *Martinet*, Clinique Méd. de l'Hôtel-Dieu, 1827.—(*Davaine*, p. 586.)—Demarquay's Modification: *Paul*, L'Union Méd., 1866, 122 and 125.

In echinococci of internal organs, which are still increasing in size, we should not defer it until threatening symptoms appear, however unwilling we may be to undertake an operation, which is not without its dangers, when the derangements are still very slight. The presence of a growing echinococcus is like the sword of Damocles, continually threatening immediate danger. Hence it is, that the prospect of a favorable termination diminishes with the growth of the tumor, since, on the one hand, the cyst wall usually becomes more and more inflexible as it grows, and heals less readily, and on the other hand, the accompanying changes in other organs may become so far advanced, that, even after the successful removal of the parasite, they may cause the patient's death

Etiology and Prophylaxis.

As the echinococcus is the larval state of the tænia echinococcus, the dog, as the bearer of this tape-worm, claims the first consideration, in connection with its etiology and prophylaxis; and the other animals in which the echinococcus is found, and which may, therefore, be the source of infection for the dog, will receive secondary consideration.

When we consider the important part played by the dog as the constant companion of man, and the too intimate intercourse frequently existing between man and dog, especially in the lower classes and among persons of but little culture, the wide distribution of the echinococcus will not seem strange. Children especially are exposed far more to the danger, since an invasion by the encapsuled worms may occur much more readily in children than in adults. Even the finest lapdog is not safe, and may frequently harbor the tænia echinococcus, and transfer the eggs to its mistress's mouth by a kiss. Every one who has owned dogs is aware of their habit of frequently applying the nose to the vicinity of the tail; this may be a matter of toilet with them, or it may be done in the search for epizoa. The greatest possible limitation of intercourse with dogs is therefore the first step in a rational prophylaxis.

The tænia echinococcus occurs also in wolves,[1] and perhaps in other carnivora; but here they are of no consequence.

The matter of preventing dogs from acquiring the tænia echinococcus is, therefore, of special importance. Of the animals besides man in which the echinococcus is found, only the cow, the sheep, the hog, the goat, and perhaps the horse and the deer, need be considered. This, then, must be attended to: "water-blisters" of all kinds which are found in these animals must not only, as is the usual custom, be cut out and thrown away, but should be burnt or destroyed in some such manner as will prevent the dog from swallowing them. The dangers incurred by neglect of these matters should be made known to the community.

Although the tænia echinococcus has not yet been observed in the intestines of man, we must not lose sight of the possibility of such an occurrence, and of *self-infection* from such a source. Therefore the most careful excision of all "water-blisters," especially of the livers of slaughtered animals, is to be practised, so that the remaining flesh may not become infected with scolices either on tearing or carving it. It is best to consider as suspicious every cyst containing a watery fluid, as a fine discrimination cannot be expected on the part of the public.

After all that has been already stated, it is scarcely necessary to mention that man is neither exposed to the echinococcus by the use of raw smoked meat, as Hjaltelin[2] believes, nor by hereditary transmission. A clear comprehension of the etiology can alone give us the foundation for a prophylaxis. Thus Richardson[3] traces the frequent appearance of the echinococcus in Victoria (Australia), especially among the shepherds, to the use of mutton as food. The sheep, without doubt, acquire echinococcus from the shepherd dogs.

Section II.

ECHINOCOCCUS OF INDIVIDUAL ORGANS.

1. Echinococcus of the Brain.

The occurrence of the echinococcus within the skull is infrequent, and it only exceptionally attains a notable size in that situation, as it usually causes the death of the patient too early for this to occur. The echinococcus is found in the brain, in all its parts, and between the membranes; it is seen in a free state at the base and in the ventricles. The brain substance is supplanted by the growing parasite, and there is sometimes a condition of softening of the neighboring tissue, which again may be hardened and sclerosed. The membranes are, at times, thinned, and in other cases thickened and œdematous, and the ventricles distended. Not infrequently the roof of the skull is absorbed and perforated by the growing parasite, which then makes its appearance externally. It may also extend into the nose and orbit, and may induce exophthalmos.

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[1] *Cobbold*, Entozoa. London, 1864, p. 261.

[2] *Hjaltelin*, Jahresbericht, 1870, I., p. 231.

[3] *Richardson*, l. c.

On the whole, the *symptoms* which indicate an intracranial echinococcus differ but little from those of other tumors of slow growth. The principal and most frequent are headache, dizziness, vomiting, syncope, and spasms, at times of an epileptiform character; disturbances of the motor and sensory functions, as also of the mind, are observed. Continuous violent headache is sometimes the only symptom. A persistent trigeminal neuralgia[1] was, in one case, the only symptom of an echinococcus sac, nine centimetres long, situated in the right cerebral hemisphere. Westphal[2] makes special mention of an intermittence of the symptoms, with now and then an intensified recurrence.

The compression which the echinococcus, by its size and extent, exercises on both hemispheres, or often only on single nerves, causes a multiplicity and peculiar grouping of the symptoms, which differ strikingly from those which were formerly considered as characteristic either of acute or of chronic brain disease. The symptoms usually increase suddenly in severity, and cause death in a short time. A spontaneous discharge externally, with subsequent cure, but seldom takes place.[3]

The *diagnosis* of echinococcus of the brain is extremely difficult, and is rendered possible only by the further presence of the parasite in some more accessible locality, or when it breaks through the skull and reveals itself externally as a fluctuating tumor. The slow growth and the absence of fever make the diagnosis probable; an exploratory puncture may render it positive.

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[1] *Visconti*, Annali univers. di med., 1869, p. 84.

[2] *Westphal*, Berlin klin. Wochenschrift, 1872, No. 18.

[3] *Moulinié*, Gaz. des Hôp., 1836, X., p. 303 (*Davaine*, l. c., p. 648).—*Westphal*, l. c.

The *prognosis*, if not absolutely bad, is at least very unfavorable.

Naturally, the *treatment* is purely that of combating the symptoms. On suspicion of the presence of an echinococcus, a course of the iodide of potassium should not be omitted. Should the situation of the echinococcus be determined, especially by its breaking through the roof of the cranium, an exploratory puncture, with subsequent gradual withdrawal of the contents, should be attempted. For this purpose Sibson's[1] method is the best. He punctures with a hypodermic syringe, withdraws some fluid by pulling back the piston, then replaces the syringe by a small tube, and allows the echinococcus fluid to drain away through this; should it be necessary, especially if the diagnosis be verified by the examination of the fluid thus obtained, an incision may subsequently be made.

Davaine (p. 651) enumerates thirty cases of echinococcus within the cranial cavity, in eight of which the parasite was situated outside the membranes of the brain. Several of these cases—especially No. 22—may be considered doubtful.

2. Echinococcus of the Spinal Cord.

The echinococcus is less frequently found in the spinal cord than in the brain.

The parasite may here develop in three different modes; it is extremely infrequent for it to have its primary seat within the sac of the dura mater; it occurs somewhat oftener outside of it, yet originally in the vertebral canal; it usually forces its way from without into the vertebral canal by widening the intervertebral foramina, or it makes a path by absorption of the vertebra. The echinococcus has not yet been observed in the substance of the spinal cord. Those developed primarily within the vertebral canal, but outside the sac of the dura mater, escape into the adjoining parts by the same routes, only reversed.

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[1] *Sibson*, Lancet, 1868, p. 75.

Altogether only twelve cases of echinococcus of the vertebral canal have been recognized; of these, six were originally situated without and six within the canal; of the latter, two lay within the sac of the dura mater.[1] In one case which I saw dissected in 1870, in Guy's Hospital, London, the echinococcus had crowded out of the vertebral canal anteriorly, to the right and left, into the pleural cavities, and also posteriorly by numerous ramifications into the muscles of the back.

An echinococcus lying within the sac of the dura mater flattens the spinal cord; the underlying portion of the cord is markedly softened, and the blood-vessels seem much distended. The effects of those lying without the dura mater are similar, but probably the changes do not make their appearance until somewhat later.

The *symptoms* of an echinococcus in the spinal canal are scarcely distinguishable from those which appear during the development of other neoplasms. Disturbances of innervation are noticed from the beginning in the parts supplied by the nerves which emerge below the parasite, particularly pains in these parts; then pains in the vertebræ appear, which are increased by pressure; following these come numbness and formication, merging into complete anæsthesia, and difficulties of locomotion which may amount to complete paralysis; sometimes there are cramps and muscular twitchings, paralysis of the bladder, rectum, and abdominal muscles, and dorsal decubitus, with complete extension of the limbs.

If the echinococcus is situated in the lowest portion of the vertebral canal, all symptoms may be absent.

The *duration* of the disease, from the beginning of the first symptoms until death, varies from one month to five years. Recovery has not yet been observed.

For the *diagnosis*, *prognosis*, and *treatment*, the same holds good as was said with reference to echinococci of the brain.

3. Echinococcus of the Respiratory Organs.

The echinococci which are found in the respiratory apparatus either develop originally in the thoracic cavity or they force their way into it from the vicinity, usually from the abdomen.

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[1] *Bartels*, Deutsches Archiv f. klin. Med., V., p. 108. 1868.—*Davaine*, l. c., p. 669.

The former, in the large majority of cases, are situated in the lung tissue itself, and chiefly in the lower lobes. They seldom occur in the pleural cavity, in the subpleural cellular tissue, or in the mediastinum. As a rule, only one sac is found; the cyst wall is usually frail and thin, and does not undergo retrograde metamorphosis. After attaining a considerable size, the echinococcus frequently occupies one whole side of the thoracic cavity, compressing the lung against its hilus or its apex. The heart is displaced to the opposite side, toward the right or the left axilla, or the epigastrium, according to the situation of the parasite. The diaphragm is pressed downwards, and the adjacent abdominal viscera are consequently forced down. The intercostal spaces of the affected side are more or less bulged.

After a still further growth, the echinococcus may pierce the chest wall, or the depressed diaphragm and abdominal wall, and an evacuation occur externally. Far more frequently, however, the bronchial tubes are penetrated, and the echinococcus and its contents—fluid and daughter sacs—in course of time expectorated; the cyst-wall shrivels and cicatrizes, and the younger and frailer the cyst is, the more rapidly does this occur; older ones, with thickened and unyielding walls, heal only after a long-continued illness, or cause death from exhaustion.

An opening into the intestinal canal, with discharge of the contents at stool, is an extremely rare occurrence.

The penetration of the echinococcus externally, and its discharge, is a very fortunate result. The majority of such cases terminate in recovery.

Its penetration into the pleural or pericardial sac (which, of course, happens but seldom), is, however, very dangerous; usually occasioning fatal pleurisy or pericarditis.

Of the echinococci originating outside of the thorax, we shall consider only those of the abdomen, which usually find their way into the chest by perforation of the diaphragm. In general, the preceding statements apply to them; they may open into the lungs and air-passages, or into the pleura or pericardium, with the same results. These far oftener occasion effusions into the two last-named cavities, than do those which are developed in the lungs, since in the latter the pleural surfaces are usually united. Very serious results may happen, however, even without penetration of the diaphragm, as the heart and lungs may be very much crowded out of their normal position (they may be compressed even up to the fourth or third rib). Generally there are echinococci of the liver, but seldom of the spleen or kidneys (vide infra).

While the echinococcus is still small, it occasions no disturbance. It has usually already attained a considerable size before the person affected applies for medical assistance. Pains in the back and sides often occur, sometimes of great severity. The most constant symptom, however, is shortness of breath, which may at times amount to suffocation. Dry cough then occurs. There is but seldom any expectoration, unless a discharge of the echinococcus takes place into the bronchial tubes; in this case, the expectoration suddenly becomes profuse; it is clear or only slightly dulled in color, thin, and inodorous, or, by long standing, offensive. Should there be secondary vesicles within the echinococcus, part of them will be discharged entire, and part collapsed and in shreds; fragments of membranes are found in the sputum, and the scolices and hooks form a sediment at the bottom. At times, there is a slight admixture of blood. At a later period, the expectoration becomes thicker, and more purulent, and afterwards more scanty, until finally, with the collapse of the empty cyst, it ceases entirely. The complete drainage may require from a few days to several months, according to the size of the sac.

In addition to these symptoms connected with the respiratory apparatus, disturbances of neighboring organs take place. A large echinococcus must cause an impediment in the pulmonary circulation, and, as the result of this, a stasis in the venous system. Deviations in the direction of the spinal column may easily be produced by a very slow growth of the parasite, especially in young persons.

The disease brought on by the presence of the echinococcus in the respiratory organs usually runs a slow course: the average duration is from two to four years; yet, besides this, there is always a period of incubation to be taken into account, since, as has been stated, the parasite may have attained a considerable size before any disturbances are noticed; at times, the first symptoms of disease are so severe that death occurs within a few weeks.

Diagnosis.

The diagnosis of echinococcus of the lungs is rather difficult. It may happen that an opening may form externally, or the tumor may be in such a position as to be palpable, and fluctuation be discovered; but usually the nature of the disease has been mistaken, and it has been considered as consumption or as pleuritic effusion.

The *physical signs* are, as a matter of course, very variable, according to its location and size, yet, as a rule, scarcely differing from those of other changes producing dyspnœa. As the parasite usually develops in the lower lobe, it may easily be mistaken for a pleuritic effusion.

Absence of respiratory sounds, of bronchophony, and of noticeable fever, together with the constant increase of size, are the chief points in the differential diagnosis. Should all possible causes of hydrothorax be absent, and the dyspnœa be very intense, with marked deformity of the thorax, the presence of the echinococcus would seem to be indicated. An exploratory puncture, which is without danger in the diseases previously mentioned, makes the diagnosis absolutely positive, in part by the discovery of the chemical constituents of the fluid, and in part by the appearance of scolices, hooks, or shreds of membrane, which, obstructing the trocar, are often drawn out with it.

Prognosis.

As the above remarks would imply, the prognosis is exceedingly variable. It is very favorable in those cases in which the opening and discharge (whether direct or indirect) occur externally. Should this not happen, the prognosis will be less hopeful, though not absolutely unfavorable; the growth may come to a standstill, and shrivelling and disappearance occur. In case of an increase of size, danger of death from sheer suffocation becomes imminent, since a more or less great, usually a very considerable, portion of lung tissue is rendered useless for respiration. Sometimes pneumonic infiltration in the vicinity or gangrene of the lung may destroy life.

Treatment.

What we have stated with reference to the treatment of the disease in general applies to both the medicinal and other treatment in this class. Patients in whom the echinococcus has opened into the air-passages or the intestinal canal require very attentive care, in order to ward off all possible complications. In case of markedly ichorous and offensive expectoration, inhalations of oil of turpentine or of atomized disinfectant fluids are to be resorted to. Good nourishment is of importance, to maintain the strength until complete recovery takes place.

In gradually increasing echinococci which do not open, and the prognosis concerning which is unfavorable from the beginning, we should not allow ourselves to be idle, but—especially where there is increasing dyspnœa—should resort to operative procedures, according to the rules laid down for thoracentesis.

4. Echinococcus of the Circulatory Apparatus.

Echinococcus of the heart is very rare, and never attains a striking size. Sometimes no disturbances whatever indicate its existence until it proclaims its presence by the alarming symptoms consequent on a rupture into the cardiac cavity; immediate or speedy death is the usual result of this unfortunate event. When situated in the right ventricle, shortness of breath and paroxysms of suffocation, lancinating pains in the region of the heart, palpitation, and exhaustion, with systolic murmurs at the apex, are not infrequently the only symptoms.

Should the echinococcus open into the cavities of the heart, the result—if into the right heart—would be an embolus composed of secondary membranes or shreds of membranes in the pulmonary artery, and immediate death; or, lung infarctions or gangrene might occur; if rupture into the left heart takes place, we have peripheral emboli, with their results. Penetration of a cardiac echinococcus into the pleural or pericardial sac excites fatal pleurisy or pericarditis.

In Oesterlen's [1] case of a butcher's servant girl, twenty-three years old, gangrene of the lower extremity, extending up to the knee, appeared suddenly; death occurred from pyæmia, after amputation through the upper part of the thigh. An echinococcus of the size of a pigeon's egg had perforated the left auricular wall into the auricle; echinococcus membranes were discovered in adherent thrombi of the common iliac artery, and an entire sac, with secondary vesicles, was found in the arteria profunda femoris.

The *diagnosis* of echinococcus of the heart may be absolutely impossible, or only become practicable on the recognition of an echinococcus tumor in another part of the body.

An echinococcus of some other part occasionally breaks into neighboring vessels, and may result in thrombosis and phlebitis, or, if it open into a large venous trunk, in embolism of the pulmonary artery.

5. Echinococcus of the Spleen.

The statements already made in the general discussion, and what will be given in respect to the liver, are applicable to some extent to echinococcus of the spleen, which is not of very common occurrence. The phenomena, apart from the situation in the left hypochondrium, are very similar.[1]

With reference to treatment, the question of extirpation of the spleen will suggest itself, especially as it has been done in one case [2] with a fortunate result.

The case was that of a woman, twenty years of age, who had had this tumor (considered to be ovarian) in the abdomen for two years.

6. Echinococcus of the Kidney.

The development of an echinococcus in one kidney is not very rare; its size may be very considerable before it gives rise to any annoyance. It first causes atrophy of that portion of the kidney in which it is situated, with subsequent rupture into the abdominal cavity, or into the thorax or bronchial tubes, into the intestine, or perhaps externally.

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[1] *Oesterlen*, Virchow's Archiv, 42, p. 404, 1868.

[2] *Wilde*, Deutsches Archiv f. klin. Med., VIII., p. 116, 1870.

[3] *Péan*, L'Union méd., 1867, Nos. 141 and 142.—Compt. rend., LXV., No. 24 (Jahresbericht, 1867, II., p. 460).

Among the most frequent is its rupture into the pelvis of the kidney; the discharge of the content sthen takes place through the urinary passages; pure fluid contents will scarcely occasion any noticeable derangement; if, however, there be secondary vesicles in it, or should the membrane of the sac be discharged, the escape cannot take place without considerable trouble. Its passage through the ureter sometimes causes impaction and stoppages of urine, with their consequences, ischuria, renal colic, hiccough, nausea, and vomiting. The pelvis of the kidney and the ureter become dilated by these repeated distentions. The passage of the membranes and vesicles through the urethra causes retention of urine and excruciating cystic tenesmus, which latter disappears when the bladder has been emptied.

A rupture in other directions is less favorable. Should an opening into the intestine occur, complete cure may be the result, but there is no little danger of suppuration of the cyst; penetration into the chest is usually followed by opening into the bronchi, as union of the pleural surfaces will have previously taken place; here, too, recovery is possible, but long-continued suppuration may cause death from exhaustion. Perforation into the abdominal cavity generally terminates in fatal peritonitis.

Diagnosis.

The diagnosis of echinococcus of the kidney is exceedingly difficult; it becomes positive only after the passage of vesicles or shreds of membrane. As the echinococcus is usually unilateral, derangements of the urinary secretion are not necessarily present. The difficulty of distinguishing it from other tumors of the abdomen has already been mentioned. A puncture can establish the diagnosis only when scolices or hooks are discovered in the sediment, or daughter vesicles or fragments of membrane in the fluid.

Prognosis.

The prognosis is not altogether unfavorable; kidney echinococci often heal spontaneously by an emptying of the sac.

Treatment.

The treatment of kidney echinococcus is almost aimless; the internal use of oil of turpentine is recommended, especially in case the sac should open into the urinary passages.

Surgical treatment has recently been proposed by Simon,[1] and offers some prospect of good results.

7. Echinococcus of the Suprarenal Capsule.

The echinococcus occurs exceedingly seldom in the suprarenal capsule. Davaine cites only one case. A very interesting case of multilocular echinococcus of this organ is reported by Huber.[2]

A master carpenter, sixty-three years of age, who had had a severe attack of pain in the right hypochondrium six years previously, was taken ill with loss of appetite, excruciating pains in the right hypochondrium, and extraordinary muscular weakness; sufficient sleep, and frequent somnolence, with extreme thirst and vomiting after drinking largely, were the symptoms which he presented. Gradual exhaustion caused his death in about three months.

Post-mortem examination showed that the right suprarenal capsule had been transformed into a tumor of about the size of a walnut; this had a fibrous capsule and a central ulcerous cavity. The tumor itself consisted of firm, callous connective tissue, with large and small alveolar spaces; the former provided with a greasy coating consisting of detritus, crystals of the fatty acids, and myeline. In the smooth-walled smaller ones were gelatinous echinococcus vesicles without scolices and hooks; these were folded together, but could easily be drawn out; in several there was a beautifully developed water-vascular system.

8. Echinococcus of the Liver.

The echinococcus, as already stated, occurs much more frequently in the liver than in all the other organs together; at one time only one specimen, at another several, may be found either in the liver alone or at the same time in that and other organs. As many as twelve or more cysts have been found in a single liver. It frequently attains a very striking size, sometimes that of a man's head, or even greater. It occurs in all parts of the liver, but by preference develops near the capsule. Its increase produces a very striking change in the shape of the organ.

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[1] *Simon*, Chirurgie der Nieren, 1871.

[2] *Huber*, Deutsches Archiv f. klin. Med., IV., p. 613; V., p. 139.

In consequence of the slow growth of the parasite, the results induced by its presence are at first very insignificant. Only when situated at the hilus, does it occasion early disturbances by compression of the bile-ducts or portal vein. In the beginning, the growing parasite crowds the liver tissue in its neighborhood, condenses it, and causes its atrophy. The connective-tissue capsule around it is formed to some extent from the neighboring parts, and also in part perhaps from a new growth of connective tissue. On further growth, large portions of the parenchyma undergo the same processes, while the remainder of the organ continues normal, or, in certain cases, shows compensatory hypertrophy.[1] At times inflammation and suppuration occur in the immediate neighborhood, either brought on by mechanical violence or without being referable to any such influence.

The echinococcus not infrequently comes in contact with the bile-ducts. The walls of one or more ducts are destroyed by the pressure of the parasite, and a communication established between them; the echinococcus then seems to be destroyed by the contact of bile, or daughter vesicles get into the biliary passages, and from thence escape into the intestine. At first, as a matter of course, only small vesicles can pass, since they crowd through under the pressure from behind of the echinococcus fluid, and in some degree also, of the secreted bile; in this manner they widen the ducts, and make them capable of admitting larger vesicles. Thus a complete emptying and gradual cure may finally take place.

In this way must we explain Barth's[2] case, in which the post-mortem examination showed no signs of an earlier perforation, and in which only two shrivelled vesicles, of the size of cherry-stones, were discovered at the posterior border of the gall-bladder, which was itself displaced upwards; three years previously a liver-echinococcus had healed spontaneously after discharging into the intestine.

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[1] Vide supra, page 569, and *Frerichs*, Klinik der Leberkrankheiten, II., p. 223.

[2] Archiv d. Heilkunde, XIII., Heft 4 and 5. (See also *Davaine*, p. 463.)

According to the opinion of certain authors, the echinococcus may develop in the biliary ducts; the cavity in which it is situated may therefore be lined with mucous membrane. This would seem to afford a simple explanation of the frequent communication with the gall-ducts, as also of the cases in which echinococcus vesicles have been found in the gall-bladder, without a liver echinococcus having been discharged into it. A case of echinococcus of the processus vermiformis,[1] shows that it may really develop in a cavity lined with mucous membrane.

An opening of the echinococcus into the blood-vessels of the liver occurs less frequently. Now and then a coexisting communication with the bile-ducts is observed. Usually, however, thrombosis of the affected vessel takes place before the occurrence of perforation.

The influence of a liver echinococcus on the adjoining parts is observed only after it has reached a considerable size. Echinococci on the upper surface of the liver are among the most frequent; they develop towards the thorax, push the diaphragm upwards—occasionally as far as the second rib—compress the lung very markedly, and displace the heart upwards and to the left. Should the echinococcus develop towards the lower surface, it would then crowd the stomach or the large and small intestines downwards, and in this way cause various disturbances of digestion, sometimes obstinate constipation. Should it compress the ductus choledochus or the ductus hepaticus, it would occasion jaundice; and should the compression affect the ascending vena cava, disturbances of circulation in its territory, and their results, would ensue.

The great majority of liver echinococci cause no severe disturbances, but shrivel and decay before attaining a noticeable size. The causes which lead to the death of the parasite are not always manifest. In certain cases it is inflammatory action, with exudation in the neighborhood of the parasite, or the access of bile into the cyst, which checks its further enlargement. External mechanical injuries, such as a kick, a blow, or a fall, often exert a very unfavorable influence on the parasite. In many cases, indeed, these causes bring on unpleasant consequences, such as severe inflammatory action or the sudden rupture of the sac, with discharge of its contents into the neighboring cavities, with almost always an immediately fatal result. The echinococcus is generally noticed only after such occurrences, and from that time forward shows such a rapid growth that the patient dates the origin of the tumor from the injury.

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[1] Vide supra, p. 568.

Spontaneous perforation of the echinococcus externally through the abdominal walls is to be considered as the most favorable termination; but, unfortunately, such a result, in proportion to the number of cases, occurs but very seldom. Most frequently the echinococcus empties into the intestinal canal; the contents, fluid and vesicles, are often discharged by the intestines in enormous quantity; sometimes ulceration of the parasite, with severe pains, seems to precede this penetration.[1] The communicating opening is frequently so contracted that the discharge can take place only very gradually; almost all such cases run a favorable course, and end in recovery. Most echinococci which penetrate into the bile-ducts run a similar course, with the same result.

Rupture into the serous cavities—peritoneal, pleural, or pericardial—is far less favorable. When this occurs suddenly, the succeeding inflammation is, as a rule, speedily fatal; but, in rare instances, a tedious recovery follows an opening into the abdominal cavity. Such a sudden penetration is always accompanied by severe pains.

A gradual extension towards the base of the lung runs its course with the symptoms of a chronic or a subacute pneumonia; either only a slight infiltration occurs in the vicinity, or a more or less extensive cavity forms, which is in immediate connection with the echinococcus sac. Should a large bronchus open into this cavity, or should one be laid open by the advancing destruction of the intermediate tissues, an abundant expectoration of purulent matter, mixed with vesicles and the remains of vesicles, would follow. On the other hand, a direct opening of the echinococcus into the air-passages is followed more or less speedily by expectoration of a large quantity of watery fluid, with vesicles and shreds of vesicles, which does not assume a purulent aspect until a later period. A great number of these cases result in recovery, following gradual diminution of the expectoration; while others end fatally from hectic fever.

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[1] *Tüngel*, Klinische Mittheilungen, etc. Hamburg, 1864, p. 87.

Rupture into the vena cava usually destroys life at once, by embolism of the pulmonary artery.

Of one hundred and sixty-six cases of liver echinococcus,[1] four are recorded as having penetrated into the thorax, nine as having opened into the pleural cavity, twenty-one into the base of the lung or into the bronchi, eight (?) into the bile-ducts, eight into the peritoneum, twenty-two into the intestinal canal, and ninety-four in other directions.

The *symptoms* produced by the presence of the echinococcus in the liver are about as various as the fate of the parasite itself. At post-mortem examinations, liver echinococci are very frequently found, without any derangements whatever having betrayed their presence during life.

Of seventeen liver echinococci which were found in the Berlin Pathological Institute, thirteen had given rise to no symptoms during life.[2]

Only on further growth do those symptoms usually appear, which are to some extent of a general, and in part only of a local nature. As a rule, no pain is present so long as there is no inflammatory action; but in the case of cysts of large size there is an unpleasant and continuous feeling of compression, fulness, or tension.

Jaundice is observed but seldom, and only under certain circumstances, either when the tumor compresses a large trunk of the hepatic duct or the ductus choledochus, or when the cyst is in connection with the bile-ducts, and echinococcus vesicles or membranes passing through produce a temporary stoppage, or finally, when the presence of the parasite occasions inflammation and abscess of the liver.

Dropsical symptoms are likewise rather rare, and are produced only by the pressure of the tumor upon the portal vein or inferior vena cava, or as the result of general hydræmia in the later stages of the disease.

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[1] *Davaine*, p. 376.

[2] *Rother*, Dissert. inaug. Berlin, 1867.

Digestive derangements are very rare consequences of echinococci of the liver.

Displacement of the thoracic viscera by an upward growth of the echinococcus, produces a short, dry cough, shortness of breath, which often amounts to dyspnœa, and palpitation of the heart, as the result of its dislocation.

The direction in which the liver increases in size is of special objective importance; according to the direction in which the parasite enlarges, the limits of the liver are found displaced upwards as far as the second rib, or downwards to the pelvis. The abdomen may be enormously enlarged, the right half of the thorax seems very much distended, immovable, and the intercostal spaces widened, and sometimes bulging. In cases of development forwards and downwards, the tumor becomes tangible, and its limits may be determined. Sometimes an echinococcus may be overlooked by reason of a dilated gall-bladder.

Diagnosis.

What was stated in the general division applies here to the diagnosis, prognosis, and treatment.

But the echinococcus multilocularis presents a few peculiarities. As a rule, the first symptom, in addition to gastric irritation, is icterus, which, only slight in the beginning, soon increases in intensity, until it reaches the highest degree. In some cases, however, jaundice is absent; there is usually, at the same time, a feeling of fulness and uneasiness in the abdomen, and sometimes attacks of diarrhœa come on at intervals; the stools appear colorless, but among them may be some of a very dark color. Examination of the liver generally shows a well-pronounced enlargement, which at times increases to enormous distension of the abdomen; the surface of the liver is generally smooth and hard; knotty tumors are but seldom felt. The spleen is invariably enlarged. The urine appears dark, at times almost black, and is free from albumen. Pain and fever to any considerable extent are but seldom noticeable. Gradual emaciation and loss of strength finally terminate in death; that event being sometimes accelerated by hemorrhages from the different mucous membranes.

The multilocular echinococcus is distinguished from carcinomatous neoplasms by the splenic enlargement and the usually smooth surface of the liver; from fatty and amyloid liver, by the high degree of jaundice, as also by the general course of the disease; other affections of the liver will scarcely be confounded with it; its difference from a common echinococcus has already been stated.

Prognosis and Treatment.

The prognosis, like the treatment, is perfectly hopeless.

CYSTICERCUS CELLULOSÆ.

Chapter I.

Of the immense number of works which have been written upon this subject, we shall only make mention of the following, in addition to those which we shall have occasion to refer to subsequently: *Stich*, Annalen des Charité-Krankenhauses, V., p. 154, 1854.—*Leuckart*, Die menschl. Parasiten, I., p. 228, and Die Blasenwürmer und ihre Entwickelung. Giessen, 1856.—*Küchenmeister*, Die in und an dem Körper des lebenden Menschen vorkommenden Parasiten. Leipzig, 1855, I., p. 69.—*Davaine*, Traité des Entozoaires, p. 622.

HISTORY.

The cysticercus cellulosæ has been observed in swine from the earliest times; Göze[1] first recognized its animal nature in 1784. Werner[2] found it in man in 1786.

The proof that the cysticercus cellulosæ is the larval condition of the tænia solium was furnished by Küchenmeister, Haubner, and van Beneden.

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[1] *Göze*, Neueste Entdeckung, dass die Finnen im Schweinefleisch keine Drüsenkrankheit, sondern wahre Blasenwürmer, sind. Halle, 1784.

[2] *Werner*, Verm. intest. brev. expositionis contin., II. Lips., 1786, p. 7.

Among the Greek writers, Aristophanes was the first to mention the measly condition of the hog; Aristotle gave a tolerably accurate description of it.

The animal nature of the measle was really known to Hartmann, O. Fabricius, and Malpighi, before the time of Göze; but as their accounts were so inaccurate, and remained so long almost entirely unnoticed, Göze may rightly be called the discoverer.

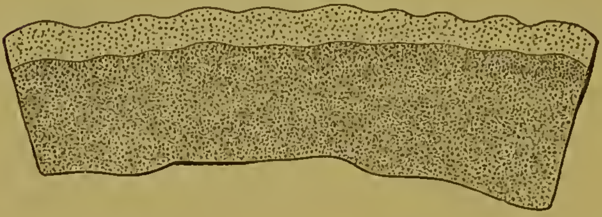
Chapter II.

NATURAL HISTORY.

The cysticercus cellulosæ is the larval condition of a parasitic tape-worm, the tænia solium,[1] found only in the small intestine of man. It is a thin-walled cyst, varying in size from that of a pea to that of a bean, seldom larger; with clear, limpid contents. Like every other foreign body penetrating into the organism, it is almost always enclosed in a connective-tissue capsule, which is supplied by the adjoining parts; if this be carefully opened, the parasite will escape as a rounded, pellucid cyst.

Fig. 16.

Flattened border of a fresh cysticercus cyst of the brain. (Highly magnified.)



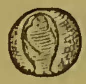


Fig. 17.

Cysticercus of the brain (natural size); a black spot shows the situation of the pigmented crown of hooks.

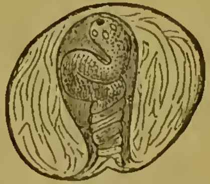


Fig. 18.

The same, with the coil magnified, the body markedly twisted.

At one point of this bag, a more or less distinct depression is observed, and within, in connection with it, a firm, yellowish or whitish body, visible through the cyst walls. On opening the cyst, this body is found to be a club-, or pear-shaped sac, in which the inverted tape-worm head is encased, its position very much resembling that of an inverted finger of a glove. This bears a very striking resemblance to the head of the tænia solium; it is furnished with four suckers and a double coronet, always consisting of sixteen hooklets, whose points form a single circle. The hooklets of the outer circle are shorter than those of the inner one, and are provided with much shorter, lever-like processes. The hooks seem to be inserted in pouches, which, like the suckers, are sometimes entirely without pigment, or may contain a little, or, in still other cases, a great quantity of it. A neck is attached to the head, and to it a short tapeworm body, which, being longer than the enveloping sac, are usually coiled and transversely wrinkled.

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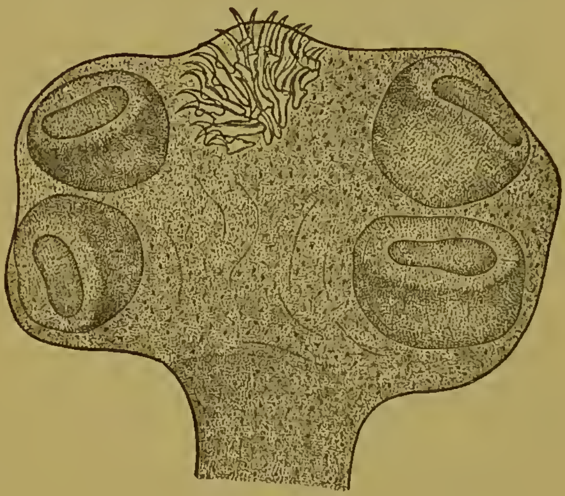
[1] See Vol. VII. of this Cyclopædia.

FIG. 19.
Head of a cysticercus of the brain. (Highly magnified.)



The surface of the cyst always seems slightly uneven; compressed from above, it seems to be surrounded by a regular, finely undulating, delicate border. This appearance is very characteristic, and is an important point in the recognition of cystic formations in which the tænia-head is no longer present. (See Fig. 16, also the border in Fig. 23.)

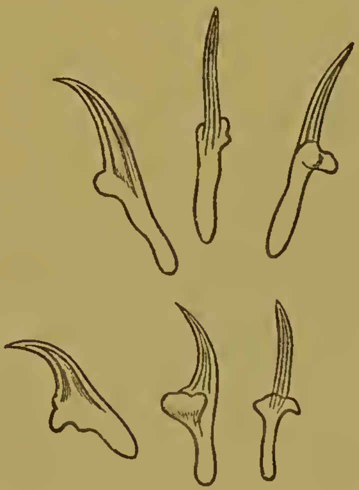


FIG. 20.
Large hooklets of the inner, and smaller ones of the outer circle, in various positions, from Fig. 19, still more highly magnified.

The cysticercus is capable of tolerably active motion; if a fresh living measle be put into tepid water, it begins to contract actively, at times backwardly, and in this manner to assume all possible peculiarities of shape; sometimes these motions appear like waves passing over the cyst wall.

In but few cases, and these in the brain, are cysticerci found "free," that is, without their connective-tissue capsule; these usually occur in the ventricles, or beneath the dura mater and the arachnoid, especially at the base, and sometimes, it seems, in the meshes of the arachnoid. In the ventricles they float around free, so that on opening the latter they are liable to escape; in other localities they often cling fast to a certain point. (Fig. 22.)

One peculiar form of such free cysticerci is observed as a very infrequent occurrence. On removal of the brain, extremely frail, veil-like formations, folded and notched in many ways, and having in some places sacciform protuberances, or sessile, frequently pediculated vesicles arranged in a racemose form, present themselves upon the base of the brain; these are usually found surrounding single nerves or arteries; here and there, by means of processes which have the appearance of being fimbriated, they cling between the fibre-bundles of the arachnoid, but without any firm organic union. They lie in some degree without, but in greatest part within, the subarachnoid space; following the arachnoid, they penetrate the third and the lateral ventricles, and there, too, form racemose masses; they also force their way between the convolutions of the brain, and there spread out. The arachnoid meshes are here and there clouded and thickened. The length of one of these sac-like formations may, in single cases, be fixed at at least twenty-five centimetres; the cysts contain a clear, serous fluid. When examined microscopically, they present the slightly undulatory surfaces of cysticercus cysts, a head seeming but seldom to be developed in them. The pathological museum of Erlangen contains two such specimens of "*cysticercus racemosus, seu botryoides*:" in one of these Prof. Zenker succeeded in finding the characteristic head of the cysticercus cellulosæ. In the second it was not present, but the nature of the formation could not be doubted.

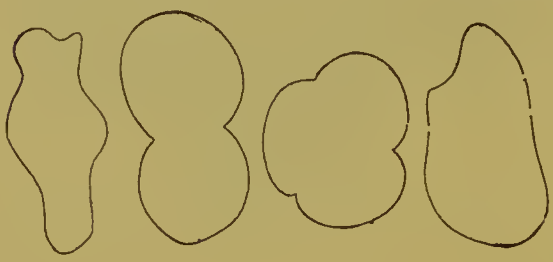


Fig. 21.

Four forms, due to contraction, of a living cysticercus.

Virchow[1] has seen three such cases of clustering cysticercus, and is inclined to the belief in the identity of these formations with the cysticercus, yet he was unable to obtain any positive proof of it.

Virchow very correctly classes his cases with three similar ones observed by Dupuytren, Forget, and Calmeil.[2] Two of Klob's[3] cases are perhaps also to be considered as low grades of this malformation.

One of the Erlangen cases occurred in a man about fifty years of age, who, having previously been in perfect health, was, thirteen years before, attacked suddenly with epileptic convulsions, which recurred from time to time; he was also very much changed in disposition, becoming sensitive and irritable. About the same time (as his wife subsequently informed me, and her testimony was corroborated by the attending physicians) he passed a tape-worm. The foregoing points form the substantial history of this case.

The way in which the embryos reach the tissues is not yet determined; they either pierce their way forward into the tissues, after penetrating the stomach or intestinal walls, or they fall upon a blood-vessel, perhaps directly, or it may be by the round-about way of the lymph current, and are thus carried to the different parts of the body (see Fig. 22). Very probably the portal vein is a more frequent route. The fact that the young measles often occur first in the liver, and afterwards leave it, to be found in other parts,[4] would support this view. Leuckart[5] succeeded, also, in his experimental feedings, in finding embryos in the blood of the portal vein.

The little six-hooked embryo having established itself in a suitable place, the irritation occasioned by it causes a slight cell-infiltration of the tissue, the hooks are lost, and a clearing begins within. This occurs conjointly with a rapidly advancing growth of the peripheral portions of the embryo, and it is soon transformed into a bag filled with a limpid fluid. A vascular network, with large and small meshes of delicate, transparent vessels, is soon formed in the wall of the sac. At one point of the wall a slight depression is seen, and a flask-shaped, hollow body, the so-called head-cone, is developed within the cyst. At the bottom of this, at its blind extremity, the development of the coronet of hooks, and of the suckers now takes place. At the same time the outer layer of the head-cone is separated from the head originating in its interior, and forms for it a cloak-like covering, which is very much extended by the further growth and increasing length of the neck and body.

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[1] *Virchow*, Archiv, 18, p. 528. Compare, also, *von Siebold*, Band- und Blasenwürmer, 1864, p. 68.

[2] *Davaine*, l. c., pp. 646 and 655.

[3] Wiener med. Wochenschrift, 1867, Nos. 8 and 9.

[4] *Zenker*, Verhandl. der phys.-med. Soc. zu Erlangen, 1865–67, p. 16.

[5] Parasiten, I., p. 199.

The formation of the measle, according to this plan, cannot, as was formerly thought, be the cause of a dropsical condition of the wandering tape-worm head, for the cyst is formed first, and in it, according to Göze's comparison, the tape-worm head is placed, as is the light in a lantern.

In but few cases does the tape-worm head escape externally while in its measly condition; this generally occurs when it reaches the stomach and is prepared for further development into a tape-worm.

The development of the cysticercus is accomplished in about two and a half months. The duration of its life, according to Stich's observations of cysticerci of the skin, amounts to from three to six years. They then die, and undergo retrograde metamorphoses. In the beginning they seem somewhat withered, their contents duller, and the vesicle less translucent; at times the inner surface of the capsule grows slightly purulent; subsequently they shrivel and become fatty, the fluid is absorbed, and lime salts are deposited both in its residue and in the callous, shrunken capsule; finally, small, hard lime concretions are found in its place. By solution of the lime salts with muriatic acid, it is usually tolerably easy to discover the circlet of hooks or single hooks scattered through the detritus.

In one of his numerous cases of cysticercus in the eye, von Gräfe[1] was able to follow the different phases of development. In from three to four weeks after the beginning of ophthalmoscopic changes, he saw cysticercus vesicles about three millimetres in diameter appear; the head and neck he saw a few weeks later, with a diameter of from four to five millimetres. Von Gräfe found the growth very vigorous during the first six weeks; the vesicles attained a diameter of six mm.; from that time on it was slower; in the oldest, which were still living—after two years—he found a diameter of eleven mm.

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[1] Archiv f. Ophthalmologie, XII., Abth. 2, p. 188.

Besides in man and swine, the cysticercus cellulosæ has been observed in the ape, the bear, the dog, the rat, and the deer; it often occurs in great numbers throughout the whole body.

Whether the cysticerci of the animals mentioned are really to be considered as cysticerc. cellulos., is not beyond doubt.

The *geographical distribution* of the cysticercus corresponds with that of the tænia solium. As man incurs the risk of the latter by the use of measly pork, it is found wherever pork is used as food; the people of nations which abstain from the use of pork are free from the tænia solium, as also from the cysticercus cellulosæ.

Chapter III.

GENERAL PATHOLOGY.

The cysticercus cellulosæ occurs in persons of all ages and in both sexes, but most frequently in middle age and in the lower classes of society.

It is found in most of the organs, most frequently in the intermuscular connective tissue of the trunk and extremities, then in the subcutaneous tissues, in the brain and its membranes, in the eye, under the conjunctiva, in the heart, more rarely in the lungs, the liver, the mesentery, and the lymphatic glands, and very seldom in the kidneys, the parotid, the pancreas, the spleen, and the bones.

Commonly only single specimens are found; but they are frequently very numerous, and at times innumerable.

I found one cysticercus in the mesentery of a child six months of age.

Delore and Bonhomme[1] found about three thousand cysticerci in one individual, of which one each was found in the heart, pancreas, and medulla oblongata, four in the cerebellum, several in the parotid, sixteen in the lungs, twenty-two in the meninges, eighty-four in the brain, 900 in the muscles, 2,000 in the subcutaneous cellular tissue and elsewhere in the connective tissue. The mesentery was filled; the liver, spleen, and kidneys were free.

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[1] Archives génér., 1865, I., p. 355.

The changes occasioned by the presence of the cysticercus cellulosæ vary according to the organs affected ; for example, while the symptoms of its presence in the subcutaneous tissue are very insignificant, or altogether wanting, in the brain and its membranes, and in the eye, the most intense disturbances appear ; yet even in these localities, with the exception of the last-mentioned, they may be scarcely noticeable or entirely absent.

The symptoms which the migration of the embryos from the intestinal canal into the body induces, have not yet been recognized in man ; the migration of a single one, is of itself an insignificant event, which can only cause a disturbance by penetrating an important organ. On the other hand, in case of an invasion in force, very important morbid phenomena must be produced by the mere act of migration from the intestinal canal, but such are not yet recognized in their causative connection with the cysticerci. With reference to this point, we are therefore referred to the results of experiments on animals, and find, of course, in such animals as have been successfully fed with tapeworm eggs, severe intestinal disturbances, diarrhœal evacuations, general weakness, and apparently also painful sensations in the abdomen.

The symptoms just mentioned were observed in a young goat fed with the tænia mediocanellata (saginata). Extreme muscular weakness and trembling came on, and the animal became unable to maintain its standing position. It recovered very gradually and continued to grow.[1]

The dissection of a goat, which died thirteen days after the first, five after the second, and two after the last feeding with segments of the tænia mediocanellata, revealed an exquisite hemorrhagic peritonitis, especially of the capsule of the liver. The hepatic substance itself was riddled with worm passages, which appeared on the surface, through the capsule, as dark, brownish-red streaks ; measles were found in many of these passages ; over some the capsule had given way, and the measles projected through the opening into the abdominal cavity ; numerous measles were found free in the peritoneal sac.

Leisering,[2] too, in the case of a lamb which died on the fifth day after being fed with the tænia marginata, found the liver swollen throughout, and hyperæmic, and embryos by the hundred in the widely dilated capillaries of the portal vein.

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[1] *Zenker*, Verhandl. d. phys.-med. Societät zu Erlangen, p. 88. 1872.

[2] Bericht über d. Veterinärwesen Sachsens, 1857–58, p. 22.

Leuckart[1] repeatedly saw animals—after being fed, of course, with an immense number of tape-worm germs—die during the first few days, sometimes even before the expiration of twenty-four hours. The autopsy usually revealed intense capillary injection of the viscera, especially of the liver and lungs, which at times showed ecchymoses.

Ulrich[2] attributes the diarrhœa and fever, which he found accompanying the presence of numerous measles under the skin, to the migration of the embryos.

At all events, careful inquiry in proper cases will be necessary to solve this question.

In most of the organs, the embryos which have penetrated them cause no disturbance of function, after their metamorphosis into cysticerci, and even after having attained a considerable magnitude, unless they are present in large numbers. For instance, they are of but little importance in the subcutaneous cellular tissue, often remaining unnoticed, even by the person affected, until perhaps they are accidentally discovered by the physician in the course of his examination.

They produce grave symptoms only when in the brain and its membranes, the spinal cord, and the eye.

Whether the development of the parasite in the muscles produces morbid phenomena, is not yet positively determined; it is denied by the majority; thus, according to Stich, no debility ensues even after complete riddling of the muscles. Probably Ferber's[3] view, that cysticerci in the human muscles may produce certain fixed symptoms, is more correct. In case of an invasion in large force, such may take the form of a severe rheumatism or gout, with muscular debility and difficulty of motion, or pain may be caused by both active and passive motion, or perhaps a febrile movement may also be present. Any practical application of the views just mentioned has thus far been impossible. The experiments on animals confirm this statement.

It is extremely desirable, in cases in which numerous muscle-measles are discovered on section, that searching inquiry be instituted among the relatives for the history of earlier chronic affections; this information will not be very difficult to obtain, since, even in cases of well-preserved measles, it would not probably extend back further than from three to six years.

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[1] Parasiten, I., p. 101.

[2] Allg. Zeitschr. f. Psychiatrie, 1872, III.

[3] Virchow's Archiv, 32, p. 249.

The description of cysticerci in the eye belongs to the province of ophthalmology.

Concerning the presence of cysticerci in the heart (which is not very infrequent) we know but little; yet cases in which the parasite is situated under the endocardium can scarcely have run their course without symptoms; a more or less severe endocarditis must have occurred.

Cysticerci of the surface of the heart usually cause but little disturbance, while the consequences of those situated beneath the endocardium are exceedingly troublesome. In one such case the entire apex of the left ventricle was occupied by a thick-walled, firm, fibrous tumor of about the size of a hazel-nut, and whose wall seemed to consist entirely of thickened, sinewy endocardium; the cavity, which was somewhat contracted about the middle, contained a well-preserved cysticercus, whose form corresponded with that of the cavity; for a considerable distance around the tumor the endocardium showed marked opacity and fibrous thickening.

Cysticerci of the brain and its membranes alone require a separate consideration, although, notwithstanding numerous valuable publications, our knowledge of the morbid conditions produced by them amounts thus far to scarcely anything.

Diagnosis.

A positive diagnosis is possible only when the cysticerci occur in situations accessible to sight or touch, especially in the eye. In such cases numerous, firm, bean-like swellings in the subcutaneous tissue should lead us to suspect cysticerci; the extirpation of such a tumor is so trifling a procedure, that its performance for diagnostic purposes should always be readily allowed.

Prognosis.

The prognosis is of importance only in cases of cysticerci of the brain, and will be discussed under that head.

Treatment.

We have thus far been unable, by any therapeutical means, to prevent the development of measles. They have been observed while the patient was under treatment by inunctions, also when under the influence of iodine, mercury, quinine, or arsenic ; no change was noticeable in any case, but their growth continued undisturbed ;[1] even picric acid seems to exert no detrimental influence on them.[2] Notwithstanding this, we should not yet give up hope of finding a remedy which will cause their death without injury to man,

Etiology.

The etiology of the disease induced by the presence of cysticerci is more satisfactory. As the cysticercus cellulosæ is the larva of the tænia solium, which has thus far been found only in the small intestine of man, infection of a man with measles can only occur after the reception of mature eggs of the tænia solium into his stomach. The person affected may derive these eggs either from a tænia solium in his own small intestine, or from the tape-worm of some other individual.

The former mode of infection — self-infection — may occur in two ways: mature eggs, either free or accompanying the detached and expelled joint of a tape-worm, may be taken into the mouth and swallowed, or mature egg-containing segments may be regurgitated into the stomach during the act of vomiting; in either case, the embryos, armed with three pairs of hooks, are set free by the action of the gastric juice, and locate themselves in some suitable position, where they undergo the above-described alterations.

The walls and seats of public privies in railroad stations, and especially in hotels, afford a sufficient explanation of the most common method by which self-infection occurs; yet it may frequently be attributed to the second mode, as many men regularly expose themselves to the danger of vomiting by over-indulgence in the use of wine and beer.

By the second method, the eggs or segments of tape-worms which have escaped from another individual, are likewise brought, perhaps by contamination of the food or utensils, or by some other means (and of these there are many) to the mouth and stomach, there to undergo the same changes.

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[1] *Stich*, l. c.

[2] *Mosler*, l. c.

Of von Gräfe's collection of eighty cases of cysticercus in the eye, only five or six patients had been previously affected with tape-worm, whilst very frequently other inmates of the room or house were giving lodgment to them.

The ability of single detached tape-worm segments to creep off, especially in damp localities, and even to mount blades of grass and the like, considerably lessens the difficulty of explaining the modes of extension and infection.

Cases of very numerous cysticerci in the body must be considered as having originated by swallowing an entire tape-worm joint, or at least a large part of one.

Butchers, bakers, and cooks who harbor tape-worms, are, in consequence of their occupations, especially likely, from lack of cleanliness, to infect the food supplied or prepared by them, and in this way to bring about the measly infection.

Every person affected with tape-worm, not only carries with him danger to himself, but is also constantly threatening the health and life of his neighbors.

Parasites in general, and brain cysticerci in particular, are frequently found in the insane, and the insanity may in many cases be attributed to their presence. Ulrich,[1] however, very correctly insists that this view should not be accepted without qualification; but that, on the contrary, mental diseases predispose their subjects to the acquisition of cysticerci, by the filthy habit of dirt-eating, and also by their proneness to besmear themselves with both their own fæces and those of others.

Prophylaxis.

Much may be accomplished in the way of preventing the formation of the larvæ. The presence of measles in an individual, proves that a tænia solium must have been present, either in himself or some other person. The first point, then, is to avoid contracting a tænia solium, which threatens to become a constant source of measly infection for the "bearer" himself, as well as for every other person living in the same house with him, and particularly for any one sleeping with him.

In order to attain this object, the use of raw or insufficiently cooked pork must be avoided; a thorough preparation of the meat, especially by boiling or roasting, until there is no longer even a rosy, not to say bloody, color remaining, kills the measles; and they do not entirely resist ordinary pickling and smoking.

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[1] L. c.

People become measly, then, not directly from the use of measly pork, as we even now sometimes read, but by the circuitous mode of the tape-worm developing in the intestine.

Should, however, a tænia solium be developed, it becomes our duty, in order to obviate danger, to accomplish the immediate expulsion of the worm; in doing this, vomiting must be avoided,[1] in order that no joints be carried into the stomach, and thus produce, artificially, the very event which we are striving to prevent. To guard against any further source of infection, the greatest precaution must be exercised with reference to the expelled segments, and, whenever possible, these should be killed with boiling water.

As a third, more indirect, but not less important, measure, we should take care that hogs are kept at a distance from privies, and in general from all places where there might be an opportunity for them to devour human excrement, and thus to infect themselves with measles. The man who raises hogs has it in his power, by careful attention to his stock, to extirpate the tænia solium and its larvæ.

An obligatory inspection of meat would further the attainment of this object, and is already being pressingly urged on account of trichinæ.

CYSTICERCUS OF THE BRAIN.

The occurrence of the cysticercus in the brain and its appendages, is relatively very frequent. It may be found in all parts, but is most frequently situated on the surface, and particularly in the pia mater, but in such a manner that it seems to be sunk in the cortical substance of the brain.

Of eighty-eight cases collected by Küchenmeister,[2] from the literature of this subject, cysticerci were found forty-nine times in the membranes of the brain (dura mater six, arachnoid eleven, pia mater twenty-three, and choroid plexus nine);

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[1] See Vol. VII. of this Cyclopædia.

[2] Oesterr. Zeitschr. f. prakt. Heilkunde, 1866 (S. A.).

fifty-nine times on the surface of the cerebrum, forty-one times in the cortical substance, nineteen times in the white substance, eighteen times in the ventricles and aqueduct, seventeen times in the corpora striata and anterior commissure, fifteen times in the optic thalami and gray commissure, four times each in the corpora quadrigemina and the pineal gland, twice each in the trigonia olfactoria, corpus callosum, and medulla oblongata, once in the olivary body, and eighteen times in the cerebellum.

Usually only single cysticerci, or a few, are found; but sometimes there are many, even hundreds; when very numerous, they are generally present in other organs also, especially in the muscles and in the subcutaneous cellular tissue.

As a rule, the cysticercus is surrounded in the brain and its membranes, as in other organs, by a firm connective-tissue capsule; the brain substance in its vicinity is frequently perfectly normal, in other cases apparently unchanged, at least to the naked eye; less frequently somewhat spongy, grayish-red, or grayish-yellow; frequently somewhat firmer or sclerosed. Under the microscope, we often find a more or less abundant development of spherical granules, and at times, also, of corpora amylacea. The youngest cysticerci have capsules which seem very thick, on account of their numerous onion-like layers; the fine layers and lamellæ must be detached before the embryo itself is reached. The laminæ themselves consist throughout of extremely delicate, smooth, pavement epithelial cells, which appear brownish on account of the hæmatoidine.

A case of about sixty cysticerci of the brain, of various sizes and stages of development, gave me, a short time ago, an opportunity to carefully investigate these circumstances; numerous muscle cysticerci were found in the same individual; nothing was learned of the symptoms during life.

In rare instances brain cysticerci are found without such connective-tissue envelopes. They belong to the above-described racemose cysticerci. This variety appears in the ventricles and at the base of the brain. In the former, they float free in the cavity; in the latter, they are at times firmly attached to an arterial trunk. The accompanying figures represent a case of this sort, which was found by Prof. Zenker. The point at which the cysticercus is adherent to the artery is especially interesting; the appearance here presented is that of a dilated spindle-shaped aneurism; the wall of the artery is very considerably thickened, and can scarcely be distinguished at the point of attachment, appearing there as if broken through and firmly united by granulation tissue to the cysticercus. It may be that the embryo developing at this point had at some previous time broken through from the interior of the vessel.

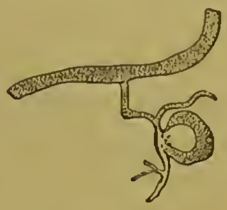

FIG. 22.

A free cysticercus at the base of the brain, adherent to an artery. The five dark points show the highly pigmented crown of hooks and the still more highly pigmented suckers. Natural size.

Some authors, and among them Stich, absolutely deny the occurrence of free (unencapsulated) cysticerci: there are, however, a few reliable observations of this variety. G. Merkel[1] found one such in the aditus ad infundibulum, in the case of a boy ten years of age. The boy (a strong and hearty one) had suffered from frequent headaches the year before his death. These occurred especially after

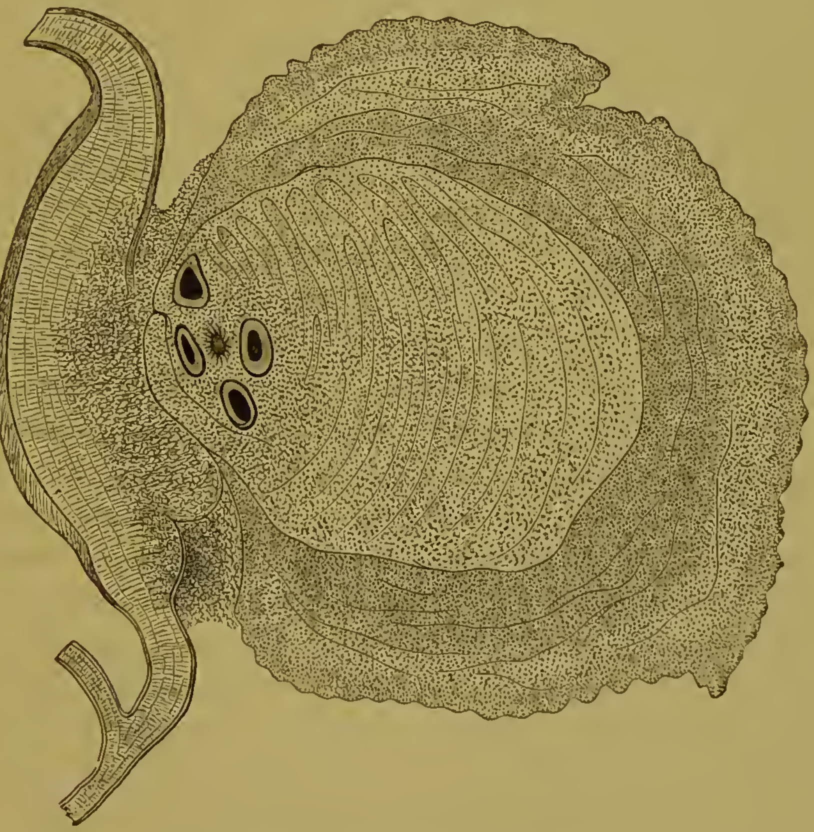

FIG. 23.

The same (slightly magnified), showing very beautifully the characteristic wavy border, also the aneurismal dilatation of the artery, the wall of which is markedly thickened and eroded at the point of adhesion.

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[1] Deutsches Archiv f. klin. Med., III., p. 297.

violent bodily exertion, and were now and then accompanied by vomiting, but were never so severe as to render it necessary to call for medical assistance. One evening he again had headache, but ate a hearty meal nevertheless, and went to sleep. After a few hours he awoke with vomiting, delirium, and great restlessness; his speech was inarticulate; complete loss of consciousness and death soon followed. Post-mortem examination revealed considerable hydrocephalus of all the ventricles; a delicate-walled vesicle of about the size of a cherry was found lying free in the aditus ad infundibulum; the head-cone was of about the size of a pin's head; the coronet of hooklets was distinct; there were no tæniæ in the intestine. From the facts that could be obtained, it seemed probable that the boy's mother had had a tape-worm two years previously.

Amongst Küchenmeister's eighty-eight cases, there were nine of free cysticerci.

The presence of brain cysticerci occasions many lesions in addition to those above mentioned, which are to be considered partly as direct, and partly as indirect results; there is nothing characteristic of cysticerci connected with the latter, but they are frequently found associated with them, and must perhaps be attributed to their presence.

Circumscribed thickenings and opacities of the membranes are found when the parasite is situated in them, together with hypertrophy of the dura mater and arachnoid at the affected points. When located in the pia mater and in the brain, the growing parasites cause compression and atrophy of the surrounding brain substance, but rarely produce purulent encephalitis in the vicinity. When in the ventricles, or near them, there is always a more or less marked chronic hydrocephalus, sometimes even when at a distance from them, as in a cerebellar hemisphere.[1] If the measles be found in only one or more of the ventricles, the effusion may be limited to these; when in one ventricle, however, it may also extend to several or all; the ependyma is usually very much thickened and granular.

An extensive pachymeningitis, with sometimes hemorrhage into the pseudo-membranes, has been repeatedly observed, especially in cases of numerous measles. Chronic meningitis and meningeal œdema, and even firm adhesions of the pia mater to the brain substance, are not uncommon; hemorrhages, both as numerous small capillary extravasations and as large apoplectic clots, have been frequently found.

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[1] *Merkel*, Deutsches Archiv f. klin. Med., III. p. 294.

Tüngel and Ferber[1] have already called attention to the increased predisposition to disease of the brain caused by the presence of cysticerci. This depends partly upon the changes occurring in the vicinity of the parasites; and, judging from the habits of other varieties of larvæ, must be in part attributed to the fact that the embryos in the brain, before coming to rest, undertake more or less distant migrations, and in this may leave behind them extensive, but slight changes, which form the points of origin of these disturbances.

In many cases the presence of measles, even in great numbers, has produced no disturbances whatever; in the great majority, however, they bring on either slight or severer symptoms; and under some circumstances, may even cause death.

Symptomatology.

The symptoms which they induce are exceedingly diverse. both in kind and in severity; as also in the peculiar modes in which they are grouped. In numerous cases they are observed to range from the most trifling, such as headache, debility, somnolency, and giddiness, to the severer, such as slight paralytic phenomena, alterations of disposition, slight cramps and convulsions,—to the most severe paralysis, with or without epilepsy, and finally to mental derangements.

Of Küchenmeister's eighty-eight cases (l. c.), sixteen (= 18 per cent.) were without symptoms; in six they were but trifling; in five epilepsy alone was present; in four epilepsy with psychical disturbances (chiefly mental debility); in fifteen epilepsy with paralytic symptoms; in twenty-four psychical disorders (insanity) without epilepsy, of which seven were without motor or sensory disturbances; and seventeen with them (lameness, cramps, hemiplegia, paralysis, muscular twitchings). Of all the eighty-eight cases, epilepsy occurred in twenty-four, and psychical disturbances in twenty-four (resp. thirty).

Notwithstanding such numerous, and, to some extent, very careful investigations, an exact analysis of the symptoms of the disease has thus far failed to be of any essential practical utility, because in most cases the number of measles present in various situations is so great as not to allow of any positive statement as to the association of any given position in the brain with certain given symptoms. All the results worthy of note will be summed up in the discussion of the diagnosis according to Griesinger and Küchenmeister.

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[1] Archiv d. Heilkunde, III., p. 130, 1862.

In Küchenmeister's entire collection of eighty-eight cases, a single cysticercus was found in only thirteen, of which only two presented severe brain symptoms; in one of these there was a cysticercus of the size of a pigeon's egg in the fourth ventricle; in the second, one the size of a hen's egg was found in the left lateral ventricle.

The pathology and physiology of the brain still require a very careful investigation; a thorough study of the brain symptoms in cases of single measles is particularly important; yet for this purpose numerous and carefully observed cases are necessary.

Considered simply as small tumors increasing to a certain size, the symptoms of intracranial cysticerci are not distinguishable from those caused by other kinds of tumors.

Without regard, however, to their probable migration as embryos, they possess another peculiarity—the capability of contraction—by which they are distinguished from all others. According to Stich—even with Ferber to the contrary—we must pay special attention to this peculiarity, particularly in cases of free cysticerci. Whoever has once witnessed the energetic, sometimes backward contractions of living cysticerci will scarcely doubt their effect on the surrounding brain substance; the results will vary according to the locations; a contraction of all the cysticerci "*a tempo*," to which Ferber facetiously refers, is not at all necessary.

To Griesinger belongs the credit of having been the first to study closely the symptoms produced by brain cysticerci, and to examine carefully their value in diagnosis. His conclusions, however, require numerous modifications to bring them into accord with those of Küchenmeister, who afterwards undertook the same studies with far more abundant material.

Diagnosis.

A positive diagnosis of the presence of cysticerci in the brain can be made only when measles become visible in the eye (by aid of the ophthalmoscope), or in the tongue or subcutaneous tissues. But even without these, we may suspect the existence of cysticerci in cases in which other brain affections may be excluded, their well known symptoms not corresponding with the ones observed, while, on the contrary, definite symptoms are present, which point to the nature of the trouble. It is especially epileptiform attacks and epilepsy, occurring in previously healthy adults, for which no cause can be ascertained either in hereditary predisposition or in other exciting causes, such as wounds, syphilis, cardiac or arterial diseases. Ordinary epilepsy is a disease of childhood and youth. The epilepsy produced by cysticerci frequently runs a singularly short and violent course, ending in death; the infrequent attacks of the early stage suddenly become very frequent and severe; or, they appear subacute in the beginning, and afterwards come on at constantly shortening intervals, and more violently, to end in death, preceded by the appearance of other severe brain symptoms—delirium, sopor, and extreme debility. An aura may often precede an attack of epilepsy due to intracranial cysticerci, just as in the common form.

A mental disturbance appearing under the same circumstances, and characterized by depression and confusion, impairment of hearing, loss of expression, photophobia, strabismus, variations of the pupils, headache, dizziness, somnolency, anomalous sensations in the limbs, muscular twitchings, or slight cramps, must at least arouse suspicion of cysticerci. Proof of the presence of a tænia solium in the patient, or in any of the inmates of the house, either at this time or a short time previously, serves to strengthen the suspicion.

Prognosis and Treatment.

The prognosis must be considered extremely unfavorable in all cases in which even only a probable diagnosis is possible.

In regard to treatment, there is nothing to be added to what has already been said.

TRICHINÆ.

Chapter I.

The literature concerning the Trichina spiralis is so copious that it would far exceed my allotted space, even omitting that which is entirely worthless, to give anything approaching a full description of the multitudinous speculative theories respecting this dreaded parasite; I therefore limit my quotations to the most important, yet others will occasionally be referred to.

Zenker, Virchow's Archiv, 18, p. 561, 1860.—Deutsches Archiv für klin. Med., I., p. 124, 1866. Ibid., VIII., p. 388.—*Virchow*, Archiv, 18, p. 345, 32, p. 322, 1860. Lehre von den Trichinen, 3 Aufl. Berlin, 1866.—*Leuckart*, Untersuchungen über d. Trichina spiralis, 2 Aufl. Leipzig, 1866.—*Pagenstecher*, D. Trichinen, 2 Aufl. Leipzig, 1866.—*Rupprecht*, Die Trichinenkrankheit im Spiegel der Hettstädter Endemie. Hettstädt, 1864.—*Kratz*, Die Trichinenkrankheit in Hadersleben. Leipzig, 1866.—*Renz*, Die Trichinenkrankheit des Menschen. Tübingen, 1867.—*Gerlach*, Die Trichinen. Hannover, 1866.—*Kühn*, Mittheilungen des landwirthschaftl. Instituts der Univers. Halle, 1865.—Wiener Comité-Bericht, Oesterr. Med. Jahrb., XIII., p. 53, 1867.

HISTORY.

The history of the trichina spiralis is naturally divided into three periods of time. The first comprises the time in which only the calcified trichina capsules were discovered in the muscles, without their nature being recognized—from 1821, or 1828, to 1835. The case reported by Tiedemann[1] is disputed because the description was superficial and the principal stress was laid on the chemical investigation. In the museum at Guy's Hospital, London, we find Peacock's[2] muscular preparation with calcified trichina capsules, deposited in the year 1828. Hilton[3] in 1821 first described the calcified trichina capsules, but considered them as cysticerci.

Tiedemann's case seems to belong here, as he evidently only incidentally described the exterior appearances, and attached the principal importance to the chemical examination; hence the accounts of the size of the lime concretions, which far exceed those of the capsulated trichinæ. Yet, such great enlargements have frequently been observed in hogs,[4] in part as the result of inflammatory processes, and in part owing to an excessive deposit of calcareous matters. Müller,[5] for example, found concretions that were four or five times larger than usual, and in one case he was able to prove positively the presence of trichinæ.

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[1] *Tiedemann*, Froriep's Notizen, I., p. 64.

[2] *Cobbold*, Entozoa, Supplement, pp. 1–8.

[3] *Hilton*, Lond. Med. Gaz., 1833, XI., p. 605.

[4] *Berkhan*, Virch. Archiv, 37, p. 1, 1866.

[5] *Müller*, Virch. Archiv, 37, p. 253, 1866.

The second period—from 1835 to 1860—begins with the discovery by Paget[1] of the round worm contained in the capsule; Owen[2] described it accurately, and gave it the name trichina spiralis. For further explanations of its interior structure we are indebted to Bristowe and Rainey,[3] A. Farre,[4] and Henle.[5] In 1847 Leidy[6] discovered in a hog capsulated round worms, which did not differ in any respect from the trichina spiralis which he had often found in human muscles. Luschka[7] in 1851 recognized the finer end of the worm as the head, in opposition to previous observers who had considered the blunt extremity to be the head.

Herbst[8] reared muscle trichinæ in young dogs by feeding them with trichinous flesh from a badger, yet the account of his experiments is very unsatisfactory owing to his inaccurate description of the worms, and to the fact of his confounding them with all other possible varieties of round worms. In 1855 and 1856 Leuckart[9] saw, in mice which had been experimentally fed, intestinal trichinæ escape from their capsules and increase to double their former size. Küchenmeister[10] in 1855 declared his belief that the trichina spiralis was the larval state of the trichocephalus dispar. Leuckart[11] then—1859—claimed that by feeding trichinous flesh to hogs he had bred trichocephali by thousands; while Virchow[12] at the same time saw the trichinæ fed by him become, in the intestine of the dog, mature, sexual, egg-containing animals; their transformation, however, into trichocephali he considered not impossible, but questionable.

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[1] *Cobbold*, l. c., and Lancet, 1866, p. 269.

[2] *Owen*, London and Edinburgh Phil. Magaz., 1835, p. 452, and Trans. Zoolog. Society, Vol. I., p. 315, 1835.

[3] Trans. Path. Society London, 1854, V., p. 277.

[4] *Farre*, Lond. Med. Gaz., 1835-36. (Froriep's Notizen, 48, No. 1035.)

[5] *Henle*, Müller's Archiv f. Anat., etc., 1835, p. 526.

[6] *Leidy*, Annals and Magaz. of Nat. History, XIX., p. 358, 1847.

[7] *Luschka*, Zeitschrift f. wissenschaftl. Zoologie, III., p. 69, 1851.

[8] *Herbst*, Göttinger Gel.-Nachrichten, 1851, No. 19, and 1852, No. 12.

[9] *Leuckart*, Archiv f. Naturgeschichte, 1857, II., p. 188.

[10] *Küchenmeister*, Parasiten, 1855, p. 269.

[11] *Leuckart*, Compt. rend., 1859, t. 49, p. 452.

[12] *Virchow*, Deutsche Klinik, 1859, p. 430.—Compt. rend., 1859, t. 49, p. 660.

Leuckart,[1] by the way, reduces this estimate from "thousands" to "dozens," which mistake had been brought about by an oral misunderstanding.

It was in the course of this year that a very considerable number of human corpses with numerous capsulated trichinæ were found; in England alone, up to the year 1836, fourteen cases[2] were seen, and up to the end of that decade, twenty-four; trichinæ were found several times in America by Bowditch[3] and Leidy,[4] as also in numerous bodies in Germany by Virchow,[5] Zenker,[6] and others.

The third period begins with the year 1860; in this year a decisive turning-point was reached in the history of the trichina spiralis. Up to that time it had been considered more as a curiosity, which at best, in common with many other parasites, roused a purely scientific interest. With the exception of Wood,[7] who propounded the question, whether a case of severe rheumatism observed by him might not possibly be connected with the trichinæ found, all had unanimously considered them innocuous, and some had positively affirmed that they produced no disturbances whatever.[8]

All of a sudden the subject assumed an aspect of great practical importance through the publication of Zenker's famous case;[9] and the seemingly insignificant and harmless intruder was unmasked as a formidable foe, threatening the health and life of man. In a girl admitted to the Dresden hospital as a case of typhus, and who died after remarkably grave symptoms, specially referable to the muscular system, Zenker recognized the freshly migrated trichinæ in nearly all the muscles as the cause of the disease, found great numbers of mature intestinal trichinæ in the intestinal canal, and pointed out swine as the original carriers of the parasites, which taken into the intestine there attain complete development. Thus the whole theory of trichinosis was furnished by the leading features of one case; at the same time a clear light was thrown over a large series of obscure cases of disease, and a secure foundation gained for the recognition of numerous groups of cases, some of which occurred at that very time, and others since.

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[1] *Leuckart*, Untersuchungen über Trichina spiralis, I Aufl., p. 7, 1860.

[2] *Pagenstecher*, Die Trichinen, 2 Aufl., p. 8. Leipzig, 1866.

[3] Boston Med. and Surg. Journ., 1842–1844. (*Cobbold*, l. c., p. 429.)

[4] L. c.

[5] Die Lehre von den Trichinen, 3 Aufl., p. 29, 1866 —Archiv, 18, p. 330, 1860.

[6] *Zenker*, Deutsches Archiv f. klinische Med., VIII., p. 389.

[7] *Wood*, Lond. Med. Gaz., 1835.

[8] *Cobbold*, l. c., p. 336.

[9] Virchow's Archiv, 18, p. 561, 1860.

A girl, aged 20, previously healthy, had been ailing from Christmas, 1859; she was forced to go to bed on New-Year's day, and on January 11, 1860, was admitted to the Dresden hospital. The symptoms in the beginning were great debility, sleeplessness, loss of appetite, constipation, heat, and thirst. In the hospital high fever, a swollen and painful condition of the abdomen, extreme tenderness of the muscular system, especially of the extremities, contractions of the knee- and elbow-joints, and œdematous swellings, especially of the leg below the knee, were observed. Death subsequently took place, with the symptoms of pneumonia. The autopsy revealed only an extensive collapse of the left lung, interspersed with small infiltrated spots, intense bronchitis, and marked hyperæmia of the mucous membrane of the ileum. The microscopic examination of the muscles showed in every preparation dozens of the trichinæ lying in the muscular parenchyma in all forms, curled and extended, and giving the most positive signs of life. Together with these there were many shorter, broader, younger specimens. In every drop of intestinal mucus were numerous sexually mature trichinæ, the males one and a half and the females four mm. in length. It was found, that, on the estate at which the girl had served, a hog had been killed December 21, 1859; Zenker discovered very numerous capsulated trichinæ in the remaining preserved hams and sausages (previously to this time only Leidy had found trichinæ once in swine; see above). It then appeared that the hostess, the proprietor, and the remaining inhabitants of the place were sick at that time, the two former undoubtedly from trichinosis; the butcher who had killed the hog was also taken very ill with symptoms of trichinous "gout."

At the same time Virchow and Leuckart were engaged, independently of each other, in investigations on trichinæ, and their researches were of exceeding value in giving us a clearer and fuller understanding of the subject.

The theory of trichinosis had then in its essential points reached the following form:

1. Man becomes infected with trichinæ by the use of trichinous pork (Zenker).

2. The muscle-trichinæ in the stomachs of mice become freed from their capsules (Leuckart), and develop, in the intestines of

dogs and cats (Virchow), as also in that of man (Zenker), to mature sexual worms—intestinal trichinæ—which

3. Attain their full growth at the end of about seven days and give birth to living young (Leuckart);

4. These young trichinæ migrate directly from the intestine in which they are situated into the muscles of the same person or animal (Zenker, Virchow), since

5. During their migration they are found in the mesenteric glands, abdominal cavity, and pericardium (Virchow).

6. They penetrate into the interior of the muscular fibres (Virchow), and cause the destruction of the contractile substance (Virchow, Zenker).

7. Within the muscles they grow to perfect muscle-trichinæ (Zenker, Virchow, Leuckart);

8. These migratory processes bring about in man a severe febrile disease—trichinosis (Zenker), which

9. May result in death, both in man (Zenker) and in animals (Virchow).

10. Cases of capsulated trichinæ are to be considered as healed cases of trichinosis (Zenker).

As the investigations of the three observers already mentioned—Leuckart, Virchow, and Zenker—took place independently of each other, and in part almost simultaneously upon specimens from Zenker's case, it was not easy to determine the merits of each from his publications; both Virchow[1] and Zenker[2] were compelled to defend their rights, in the matter of developing the theory of trichinosis, against Leuckart,[3] who was constantly appearing in print with incomplete notices. After a very careful examination of the publications of these authors, I have endeavored to convey a correct idea of their respective merits by appending their names, in their rightful places, to the foregoing propositions.

That trichinosis could hardly be an uncommon disease was to be inferred from the frequent early discoveries of capsulated trichinæ; the number, however, of single cases as well as of groups of cases (epidemics), which have either come to our notice recently, or of whose existence in earlier times we have since learned, is unexpectedly large. As regards the latter, the evidence is based in part on the careful reports of a series of epidemic cases, and in part on the accidental discovery of trichinæ in those who at that time had recovered from the disease.

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[1] *Virchow*, Archiv, 32, p. 332, 1865.

[2] *Zenker*, Deutsches Archiv f. klin. Med., I., p. 90.

[3] *Leuckart*, Archiv des Vereins f. wissenshaftl.. Heilkunde, II., pp 57 and 235.

Among the epidemics now known with more or less certainty to have occurred in the past, the oldest is probably the one in Würtemberg, in 1675, reported by Fehr;[1] it occurred in the family of a miserly farmer. The cause was shown to a certainty to have been pickled and smoked pork. The farmer and his son died; all the remaining inmates of the house who had partaken of the meat were taken ill. Of others, a series of cases in Niedermitlau[2] in the province of Hanau, 1834–1837 in Wurzen, 1858 in Breslau, 1858–62 in Magdeburg and vicinity, 1859–62 in Blankenburg, 1860 in Stolberg in the Harz, and many others are worthy of note. A slight epidemic was proved to have occurred in Hamburg in 1851, by the post-mortem examination in 1865 of one who had recovered;[3] another small group, which occurred in 1845 after a meal at a school celebration, was discovered accidentally by Langenbeck through an operation for epithelial cancer.[4]

Especially interesting was the epidemic in Wegleben[5] near Quedlinburg, in 1849–50, which was subsequently recognized; it was designated at that time as "English sweat" or "black death." How many trichina epidemics (sit venia verbo) may have been concealed under the name of English sweat can only be determined by a careful study of the original records. The descriptions of this disease present such striking resemblances to those of trichinosis, that we are compelled to consider them as the same, even if important symptoms be not mentioned, or if others seem to be grouped anomalously.[6]

Le Roy de Méricourt attributed acrodynia to trichinosis.[7] By this name, or "mal des mains et des pieds," "érythème épidémique," "phlegmasie gastrocutanée aigue multiforme," etc., is indicated a disease which was observed as a widespread epidemic in Paris in 1828–29, and afterwards in various other districts of France, as for instance in Coulommiers, Fère-Champenoise, Montmirail, and Vitry; in 1846 in Belgium and in 1854 in the Crimean army. Alibert designates the disease "érythème épidémique." In order to recognize that this view is correct, it is only necessary to read the name and to recollect that the prevailing epidemic in Magdeburg and vicinity in the year 1858 and subsequently was described by Sendler[8] as "acute epidemic œdema of the subcutaneous cellular tissue and muscles." We may then compare it with an epidemic of "febris desquamat. typhodes," in 1863, in

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[1] *Fehr*, Miscell. med.-phys. cur. acad. nat. cur. Dec., 1, ann. VI., 1677, observ. 191, p. 269.

[2] *Kopp*, Denkwürdigkeiten aus d. ärztl. Praxis, III., p. 75.

[3] *Tüngel*, Virchow's Archiv, 28, p. 391, 1863.

[4] *Lücke*, Vierteljahrschrift f. gerichtl. Medicin, XVII., p. 102, 1864.

[5] *Mosler*, Virchow's Archiv, 33, p. 414.

[6] Compare *Hirsch*, histor.-geog. Path., I., p. 468, 1860, and Virch. Archiv, 8, p. 18.

[7] *Le Roy de Méricourt*, Archives génér. de méd., 1865, II., p. 620.

[8] *Sendler*, Deutsche Klinik, 1862, p. 261, No. 27, 1863, No. 2.

Züllichau and vicinity, described by Frank[1] as "epidemic morbid desquamation of the epidermis," which without doubt is to be considered as trichinosis.

According to Desnos[2] there are three series of symptoms in acrodynia: 1. disturbances referable to the intestinal canal, 2. to the nervous system, 3. to the cellular tissue of the external and internal coverings—skin, conjunctiva, pharyngeal, bronchial, and urethral mucous membranes; in the beginning there are digestive disorders, loss of appetite, obstinate œdema of the face, at times conjunctivitis and bronchitis, often vomiting and diarrhœa. Then follows stiffness of the joints, with sensations of formication, which give way to superficial and deep hyperæsthesia, painful, often convulsive sensations of different kinds, disorders of contractility, difficulty in moving painful parts, contractions, convulsions, and twitchings, and widespread erythematous redness, especially of the hands and feet; subsequently, hyperæsthesia is replaced by anæsthesia, and the convulsive symptoms by weakness or paralysis. The previously present erythema of the skin gives place to a yellow, blackish scaling of the thickened epidermis. Fever is usually absent; often, notwithstanding the obstinate sleeplessness, the intelligence remains unclouded. The recovery is complete, though convalescence may be very tedious. Duration, from a few days to five or six months. Results of post-mortem examinations entirely negative.

The epidemics especially worthy of notice since the discovery of trichinosis are: the one at Corbach in Waldeck, 1860; at Plauen in Voigtlande, 1861–2, in Calbe on the Saale, 1862; Posen, Hettstädt, 1863–4; Hannover, 1864; Dessau, 1864; Görlitz, 1865; Erlangen, 1870; Löbau, in Saxony, 1871; Göttingen, 1871. The largest one, however, spreading terror far and wide, was that in Hedersleben, 1865, in which of about 2,000 inhabitants, 337 persons were taken sick, and 101 died.

Lesser epidemics and single cases have since been noticed all over Germany and Austria,[3] but they have scarcely yet been reported in medical journals.

According to an oral report by Cobbold, trichinosis was diagnosticated for the first time in England, in Northumberland, in 1871.

Chapter II.

NATURAL HISTORY.

The trichina spiralis is met with under two forms, the intestinal trichina and the muscle-trichina. The adult, sexually mature trichina (the intestinal trichina) is an extremely fine, round, thread-like, slightly coiled worm, with a still finer head, which gradually decreases in thickness towards its point; its hinder extremity is rounded off rather abruptly; the chitinous integument of the body is slightly annulated.

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[1] *Frank*, Virchow Archiv, 26, p. 427, 1863.

[2] Nouveau Dictionnaire de Méd. et de Chirurg. prat., red. Jaccoud. Paris, 1864, I., p. 375, Article "Acrodynie."

[3] For particulars, see *Pagenstecher*, Trichinen, Leipzig, 1866, 2 Aufl., and Virchow, Gurlt, and Hirsch's Jahresberichte.

FIG. 25. Extremity of the head of the intestinal trichina. (Highly magnified.)

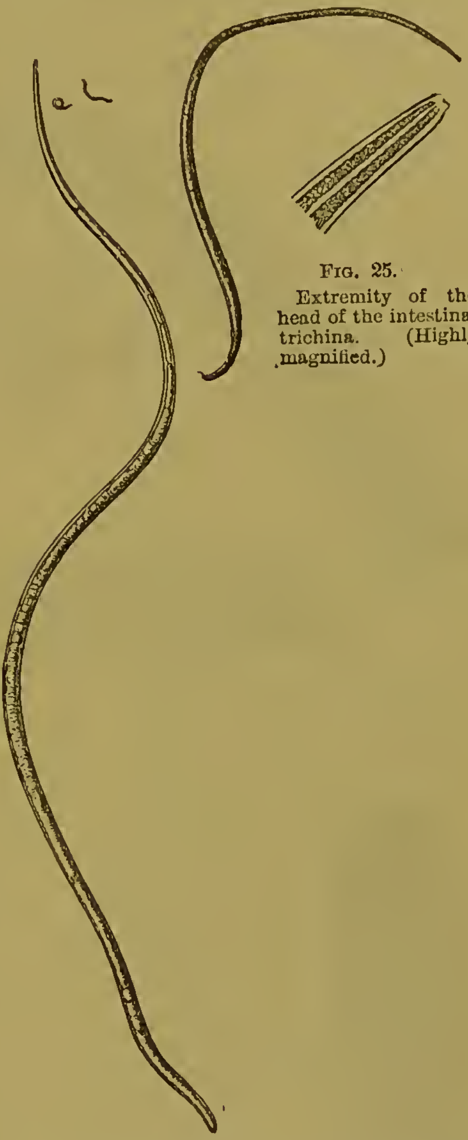

FIG. 24. Sexually mature trichinæ (male and female) and two embryos from the intestine of man. (Slightly magnified.)[1]

The digestive canal is composed of several divisions, but there is still considerable dispute regarding the arrangement of these different parts. It commences with a narrow, muscular, oral aperture, which, gradually widening, merges into the œsophagus; the latter, throughout its whole length, is grasped by the concave side of the so-called cell-body—a series of colossal cells, probably a glandular apparatus—and, together with the mouth, is lined with a fine layer of chitine. The stomach is a continuation of the œsophagus; it begins as a flask-shaped enlargement, and is lined with small, finely granular cells; at its commencement are found two small pear-shaped culs-de-sacs or appendages, which are lined with an epithelium similar to that found in the stomach. The latter, becoming constricted, soon merges without any essential alteration of structure into the intestine, which, in the hinder portion, usually seems darker on account of the abundant deposit of fine granules. The last division, the rectum, again presents a distinct chitinous lining, and, in the male, unites with the seminal ducts, forming a common cloaca.

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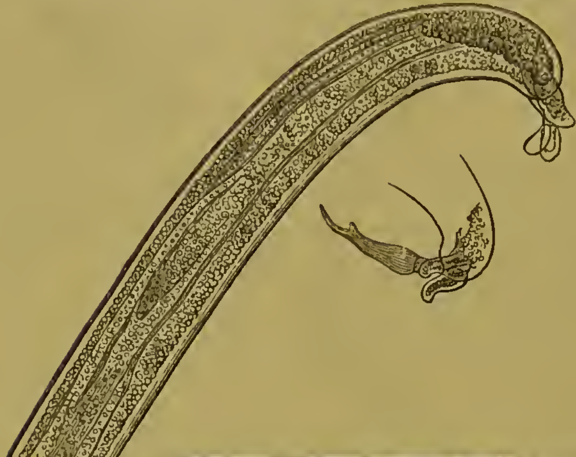
[1] The Figures 24 to 29, and 32 to 35, are after preparations from Zenker's epochal case of trichinosis. Figures 36 and 38 were drawn by M. Krantz after early Dresden cases. Figures 30, 31, and 37 are from drawings by Dr. Fiedler. The beautifully executed plates are to be found in the Pathological Collection of the Dresden City Hospital. I am indebted for them to the courtesy of Prof. Zenker, of Erlangen, and Dr. Birch-Hirschfeld, of Dresden.

Figs. 26 and 27.
Caudal end of a male, with protruding cloaca. (Highly magnified.)



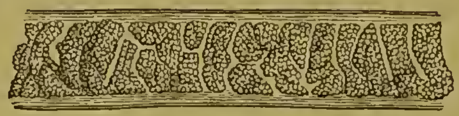


Fig. 28.
Portion of the caudal end of an intestinal trichina, five days old—eggs still undeveloped. (Highly magnified.)

The *males* attain a length of a millimetre and a half, and are furnished at the caudal extremity with two pointless, lobular appendages, and a genital opening, which, together with the end of the rectum, forms an outlet directed forwards. The internal sexual organs are already perfect, even in the muscle-trichinæ; they consist of a single testicle, which begins near the posterior extremity of the body, as a thick, knot-like cul-de-sac, then extends forwards, with gradual diminution in size, to within a short distance of the cell-body, when it turns rather short upon itself, and merges into the small seminal duct.

The sac of the testicle is filled with small, highly refractive cells; the seminal duct either appears empty and contracted, or near its extremity it has an enlargement filled with seminal elements.

The females are from three to four millimetres long; their genital opening is situated about at the junction of the first and second quarters of the whole length of the body. Only a part of the internal sexual organs of the female are present in the muscle-trichina, and part are formed during its sojourn in the intestine. The apparatus consists of a single

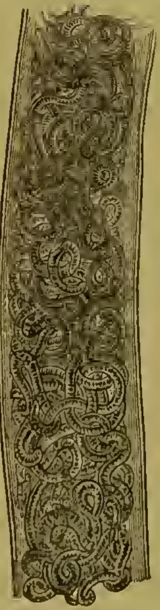


Fig. 29.
The middle portion of an intestinal trichina, with viable embryos. (Highly magnified.)

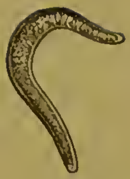


FIG. 32.
A viable embryo, from the intestinal trichina of man. (Highly magnified.)

ovary, a uterus, and a vagina. The first is originally present in the muscle-trichina in the form of a bag, which commences at the extreme posterior end of the body; anteriorly, before it reaches the stomach, it is separated from the uterus by a narrow isthmus. At its anterior extremity, in the full-grown muscle-trichina, we find the so-called "Farre's mass of granules," a collection of dark granules, which is absent in the male muscle-trichina. The eggs develop along the entire length of the ovary, but only on one wall; the young egg-cells are closely crowded together in the form of a band, which is made to appear darker by the deposition of numerous fine granules. The larger, mature, free eggs are rounded, have delicate walls, and contain each, in the midst of a perfectly clear yolk, a germinal vesicle, with a very large, oval nucleus; these eggs are

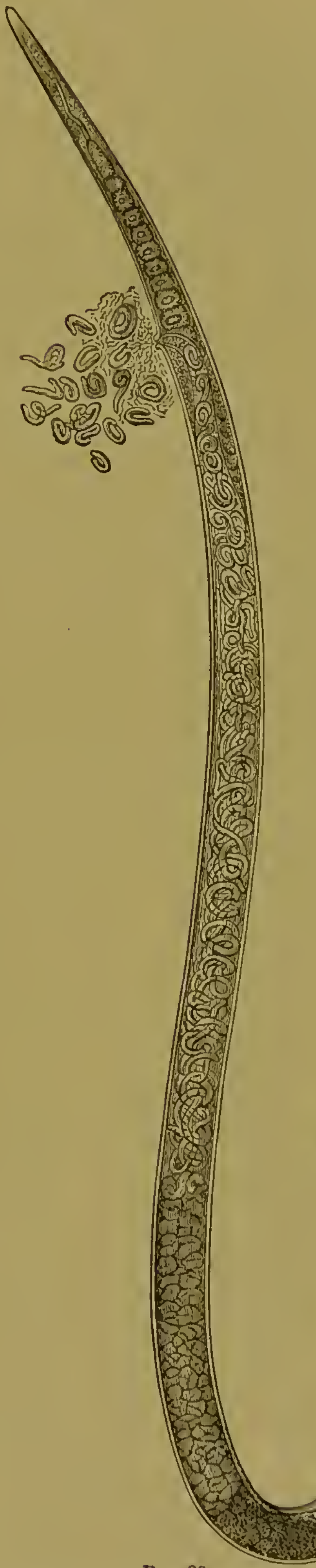


FIG. 30
A female intestinal trichina in the act of parturition. (Highly magnified).

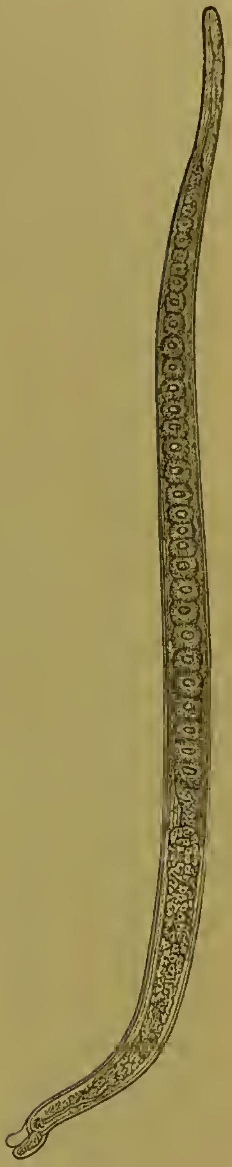


FIG. 31.
A male intestinal trichina. (Highly magnified).

pushed forwards and towards the side opposite to that upon which they are formed.

The greater portion of the uterus lies farther back than the commencement of the stomach; it is lined with a fine-celled epithelium, and will be found, if copulation has taken place, to contain the seminal elements, particularly at its posterior extremity. The uterus is gradually lost in the vagina, the anterior extremity of which is furnished with a chitinous lining from the vulva.

The embryos of the eggs develop in the uterus, and are born from one end of it free and living.

The birth of the embryos begins on the seventh day after the introduction of muscle-trichinæ into the stomach, and may continue, as it appears, for weeks. Yet, a repeated maturation of eggs, as it were in crops, seems now and then to occur.[1]

The embryos do not long remain in the intestine, but soon migrate, to settle in the voluntary muscles. The paths by which they reach the muscles are still a matter of dispute; according to some writers, part of them penetrate the intestinal wall and wander from the peritoneal cavity through the loose connective tissue towards the muscles, and a part penetrate only into the submucous tissue, and from thence into the mesentery and onwards, between its layers, and through the loose retro-peritoneal connective tissue; according to others, they reach their destination by entering the blood-vessels—either directly or by way of the lymph-currents—in which they are carried passively by the stream to different parts of the body. Probably the propagation occurs by both methods.

The great majority of investigators accept the route through the intestinal wall, the peritoneal cavity, and the connective tissue, as that which is most frequently taken; while Fürstenberg[2] has called special attention to the migration through the mesentery. Pagenstecher[3] was unable to find the embryos in the connective tissue except where it was in immediate contact with the muscle. The theory of distribution through the blood-vessels is decidedly opposed by the

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[1] *Cohnheim*, Virch. Archiv, 36, p. 170, 1866.

[2] *Fürstenberg*, Annalen der Landwirthschaft im preuss. Staate, V., 21, 1865, p. 191 (Virch. Archiv, 34, p. 469, 1864).

[3] L. c., p. 91.

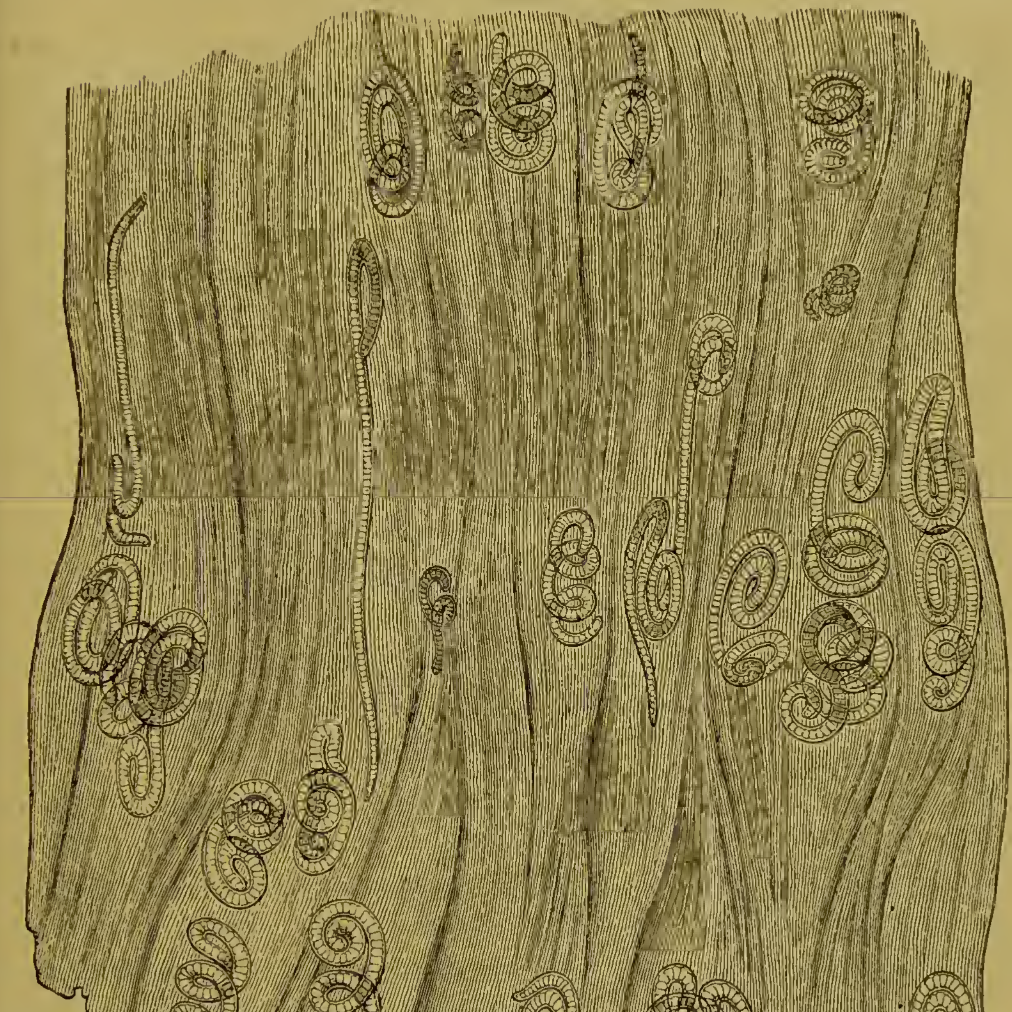

Fig. 33.

A recent trichinous immigration into a human muscle; section of the muscle near its tendinous insertion. (Moderately magnified.)

majority, mainly because they have not succeeded in discovering the embryos in the lymph and blood; they have, however, been found repeatedly in the blood,[1] and by Virchow[2] in the lymphatic glands. The passage through the organs of circulation is *à priori* so much more probable, that, notwithstanding such decided opposition, we are compelled to accept it. Fiedler, in particular, has proved by measurements of the smallest embryos found in the muscles, that, even accepting the shortest time for their journey through the connective tissue, they could not have occupied even that length of time, for, if they had, they would be found of a much larger size. According to numerous careful measurements, the embryos grow at least 0.07 mm. daily during the first few days; suppose, now, that it would take only twenty-four hours for an embryo to travel by the shortest route from the abdominal cavity to the muscles of the leg or forearm; it must even then have attained a length of 0.12 mm. (the size of the trichina in the peritoneal cavity) + 0.07 (increase of length for one day) = 0.19 mm.; as long as the migration lasts, however, we are continually finding embryos only 0.12 and sometimes only 0.108 mm. long. Leuckart's[3] objection does not sufficiently explain this difference.

Having reached the muscles they force themselves into the primitive fasciculi, cause the disintegration of their contents, increase in length and thickness, and finally roll up in coils of greater or less size. At the same time the sarcolemma of the muscular fasciculus around the trichina enlarges, and an aggregation takes place within it of oval, vesicular-shaped muscle nuclei; the trichina itself seems to be imbedded in a finely granular mass. The sarcolemma becomes considerably thickened and glossy, and the deposition of the muscle-nuclei on the inner surface contributes to its strength; at the same time a free cavity forms around the trichina itself, probably owing to its sluggish motions. The sarcolemma sheath collapses above and below the capsule, and finally becomes obliterated.

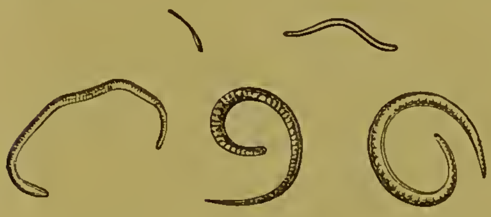

FIG. 34.
Isolated muscle-trichinæ in various stages of development. (Slightly magnified.)

In about fourteen days the muscle-trichinæ attain the greatest size ever reached by the parasite while in that state; they attain a length of from 0.7 to 1.0 mm., and they usually lie singly, or, more rarely, two, three, or even four, in one capsule. Their digestive canal, and the sexual apparatus, although the latter is not yet completely developed, are distinctly visible.

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[1] *Fiedler*, Archiv d. Heilkunde, V., pp. 5 and 472, 1864, and *Zenker*, Kühn, l. c., p. 32.

[2] *Virchow*, l. c.

[3] L. c., 2 Aufl., p. 51; Anmerkung.

As intestinal trichinæ, the intruders have a very limited duration of life; they very rarely live longer than from five to eight weeks. Observations of a longer existence may be explained on the supposition of a repeated importation.

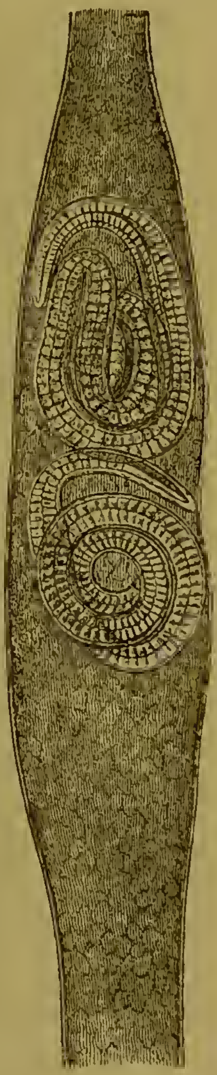

FIG. 35.

A single primitive bundle, with two free trichinæ within the sarcolemma. (Highly magnified.)

In the case of a rabbit, Pagenstecher[1] once found intestinal trichinæ even in the eleventh week.

The muscle-trichinæ have a much greater tenacity of life. Their vitality is almost unlimited, and frequently ends only after the death of the person affected. In some cases they have occasionally been found living even after the lapse of decades.[2]

After a time, a deposition of lime salts, especially of carbonate of lime, usually takes place in the capsule; this causes it to become cloudy and opaque, and, after a time, the trichina is entirely hidden. The capsules then become evident to the naked eye as small white dots or streaks, while previous to the calcification they were visible only to experienced observers. Small collections of fat cells usually develop at the extremities of the capsule, especially in well-nourished individuals. Under certain circumstances, not yet positively determined, the trichinæ die, and may decay, or a deposition of lime salts may take place in them; they petrify, break readily into pieces, and their former nature can be recognized only by the peculiar position occupied by the fragments.[3]

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[1] L. c., p. 89.

[2] *v. Linstow*, Virch. Archiv, 44, p. 379, 1868.—*Klopsch*, Ibid., 35, p. 609, 1866.—*Müller*, Ibid., 37, p. 253.—*Tüngel*, Ibid., 28, p. 391, 1863.—*Groth*, Ibid., 30, p. 265, 1864.—*Lücke*, l. c.

[3] *Luschka*, Zeitschrift f. wiss. Zool., III., Plate III., Fig. 6.

If, then, the capsulated muscle-trichinæ be introduced into the stomach of a proper animal, they will be freed from their capsules, become sexually mature within a few (usually two and a half) days, copulate, and the females will bring forth living young after five days, that is, seven days after their importation.

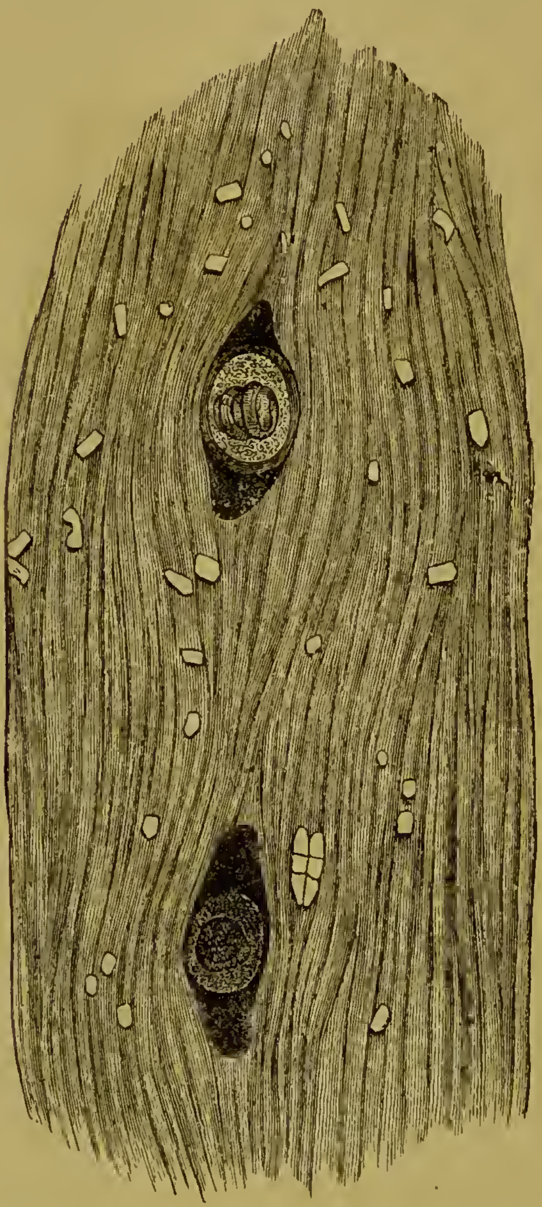

Fig. 36.
Capsulated muscle-trichinæ, with calcification of the capsules. (Magnified 80 diameters.)

In addition to men and swine, the trichina has been observed in the cat, ra, mouse, marmot, polecat, fox, marten, badger, hedgehog, and raccoon. By feeding them experimentally, the trichina has been successfully bred in rabbits, guinea-pigs, sheep, calves, and dogs; in the three latter animals, however, the experiments seem to have been only exceptionally successful; as a rule, the formation of intestinal trichinæ is the full extent of the infection in dogs.

As regards *geographical distribution*, it coincides, as it seems, with the dispersion of its principal "bearers;" like man, the hog, and the rat, it is cosmopolitan, and is found scattered over the whole earth. It has been discovered in almost all countries in which any general investigations have been instituted. In Europe, it has been observed particularly in Germany, England, Scotland, Denmark,[1] and Sweden;[2] but France,[3] Russia,[4] Italy, and the Principalities of the Danube,[5] are not free from the scourge. It is notoriously frequent in North America; the case occurring on a Hamburg vessel, which was occasioned by a hog taken on board at Valparaiso, proves that South America[6] does not escape the disease. Thus far, from Africa we have accounts of the presence of the parasite in Algiers only.[7] It appears to be frequent in India,[8] and has been observed in Australia also.

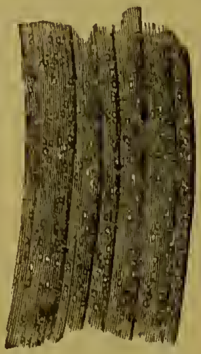

FIG. 37.

Capsulated and calcified muscle-trichinæ. (Natural size.)

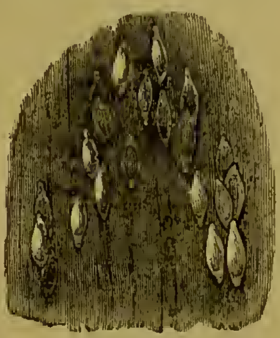

FIG. 38.

Capsulated and calcified muscle-trichinæ from the biceps muscle of a man. (Slightly magnified.)

Its frequency in England has been previously mentioned.[9]

From Scotland, Turner[10] reports that during the last five years he has found trichinæ in from one to two per cent. of all the dead bodies he has examined.

Of all the autopsies made in Dresden, Fiedler[11] found trichinæ in from two to two and a half per cent.; Wagner,[12] of Leipzig, found one in every thirty or forty bodies. As early as 1859, Virchow[13] had found numerous cases of capsulated trichinæ. Zenker[14] had discovered that 1.79 per cent. of the bodies examined in Dresden were trichinous.

Even Italy is not to be omitted, as was thought by Sangalli,[15] for Jauch[16] reports cases of trichinæ in Rovecchia (Canton of Tessin), which, although belonging to Switzerland, must be considered geographically as a part of Italy.

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[1] *Leuckart*, l. c., p. 51.

[2] *Key*, Virch. Archiv, 41, p. 302, 1867, and *Key* and *Odenius*, Ibid., 41, p. 302.

[3] *Cruveilhier*, Anat. pathol., II., p. 64.

[4] *Rudnew*, Virch. Archiv., 35, p. 600, 1866.

[5] *Scheiber*, Ibid., 55, p. 462, 1872.

[6] *Tüngel*. Ibid., 27, p. 421, 1863.

[7] *Gaillard*, Mouv. méd., 1867. p. 490 (Gaz. hebd., 1867, No 41).

[8] *Gordon*, Lancet, VI., p. 387.

[9] See p. 616.

[10] *Turner*, Edinb. Med. Journ., Sept. 1860.

[11] Archiv d. Heilkunde, VII., p. 448, 1866.

[12] Ibid., VI., p. 503, 1865.

[13] Archiv, 32. p. 322.

[14] Deutsches Archiv f. klin. Med., VIII., p. 389.

[15] Sulla organizzazione morbosa del corpo umano. Pavia, 1865.

[16] *Jauch*, Annali univers. di med., 1869, p. 72.

Its frequent discovery in American exported pork speaks positively for its prevalence in North America, as was corroborated in Rostock [1] and in Kiel, and also by the reports already referred to.[2]

Among 150 dissections in St. Petersburg, Rudnew found trichinæ three times.

Chapter III.

TRICHINOSIS.

Symptomatology.

The symptoms of trichinosis vary with the different stages of the disease, and follow pretty closely the phases of development of the trichinæ. It has been suggested that, in accordance with this, we should discriminate sharply between three well-defined periods. The first stage (Rupprecht's stage of ingression) corresponds to the introduction into the digestive canal and the development of the intestinal trichinæ ; symptoms referable to the digestive canal are the most prominent. The symptoms of the second stage (Rupprecht's stage of digression) are brought about by the beginning of the migration of the trichina embryos, and by their penetration into the muscles ; as a result of this, they appear in the connective tissue and in the muscular system. The third stage (Rupprecht's stage of regression) corresponds with the end of the migration of the trichina embryos into the muscles ; the immigrants come to rest, and the capsulating process begins. The symptoms then subside.

This division into stages may indeed be verified in some cases ; in general, however, a marked irregularity prevails, both as to the time of appearance of the symptoms after the introduction of muscle-trichinæ into the digestive canal, and also as to the order of the symptoms in general ; the course is a uniform one only in severe cases ; in light forms the single stages merge into each other, and the first especially is often entirely absent. The course is by no means so typical as in acute infectious diseases.

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[1] *Petri*, Virchow's Arch., 57, p. 269, 1873.

[2] *Bowditch*, l. c.—*Buck*, New York Med. Record, March 1, 1869, pp. 7–9.—*Groth*, Virch. Archiv, 29, p. 602, 1864.

In many light cases, trichinosis runs its course without any fever whatever, but in severe forms there is always a considerable elevation of temperature, not, however, during the first few days. The fever curve bears a marked similarity to that of an ordinary case of typhoid fever,[1] yet lighter cases present almost an intermittent type, on account of the considerable morning remissions.[2] A chill at the outset of the attack is infrequent, oftener there is only a slight shivering. The pulse corresponds to the temperature; in the beginning it varies from 80 to 90, soon mounting up to 100 or 120 beats in a minute.

The accompanying charts may serve as examples of the course of the fever in slight and severe cases.

We think it judicious—according to Kratz's example—to consider the symptoms of the disease in the order of the different organs and systems affected, and to commence with the digestive apparatus as that in which, as a rule, the first disturbances appear.

The symptoms referable to the *digestive system* are exceedingly variable; even after the introduction of

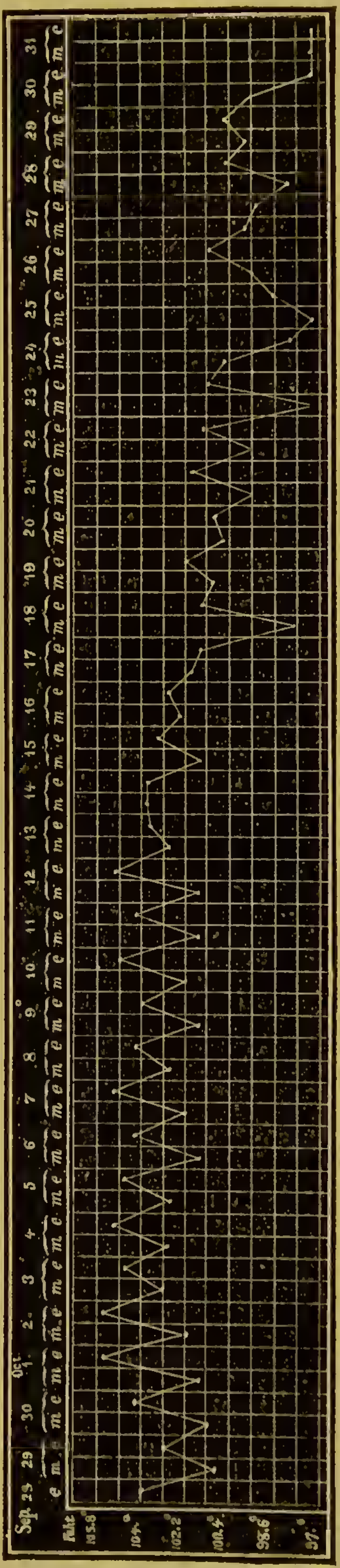

FIG. 39.

Fever curve of a severe case of trichinosis beginning about the tenth day of the disease. (After Friedreich, Deutsches Archiv f. klin. Med., IX., p. 460.)

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[1] *Fiedler*, Archiv d. Heilkunde, VI., p. 503, 1865.

[2] *Maurer*, Deutsches Archiv f. klin. Med., VIII., p. 368, 1871.

the same quantities of the infected flesh, they do not occur with equal intensity; they depend, of course, in great part, both on the quantity of the meat introduced, on the number of trichinæ taken in which are capable of development, and, finally, on the mode of preparation to which the meat has been subjected. At one time there may be an entire absence of any symptoms, at another they may be very mild, and still again they may be present in a very high degree. The gravity of the succeeding illness bears no positive relationship to the severity of the first symptoms. They often appear only a few hours after the infecting meal. Sensations of uneasiness, fulness, and nausea, even to retching or vomiting, are present in the beginning; the latter symptom occurs sometimes even after a few hours, and at other times only after several days; it may be repeated frequently, and last for whole days, or may occur only a single time or a few times.

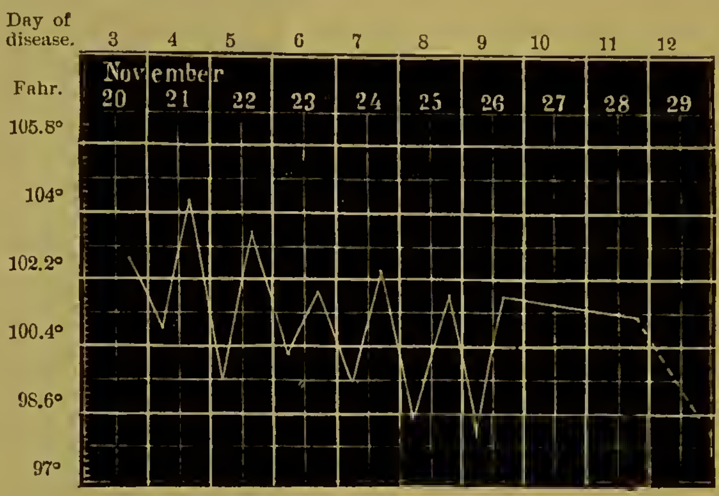

FIG. 40.
Fever curve of a mild case of trichinosis (Maurer, l. c., Fig. 3).

The appetite is exceedingly variable; often it seems entirely gone; at other times, it is not only present, but even keen; during convalescence a ravenous appetite is commonly observed. There is almost always an increase of thirst.

Diarrhœa is very frequent; at the outset the discharges are still feculent; subsequently they become very thin, clay-colored, and in some cases almost like rice water. The diarrhœa continues much longer than the vomiting; sometimes it lasts for many weeks; not infrequently, after a short duration, it gives place to an obstinate constipation; sometimes this is present from the beginning.

The majority complain of an unpleasant pasty taste in the mouth; many of a loathsome, putrid odor. The tongue presents nothing characteristic of the disease.

The difficulties of chewing and swallowing, which appear later, and increase so much that only fluid nourishment can be given, are accounted for by the parasites having migrated into the muscles concerned in these acts.

Ebstein[1] attributes the gastric and duodenal ulcers, found after death in a few cases of trichinosis, to the intense irritation of the mucous membrane of the stomach and intestines produced by the trichinæ.

The symptoms connected with the *muscular system* are the most important, next to those of the digestive apparatus.

As a single constant symptom at the outset of trichinosis, one that is present in the most severe as well as in the light cases, Kratz mentions a flabby condition of the muscles and painful sensations in them on motion,—a "muscular lameness;"—this muscular lameness has no connection with the emigration of the trichinæ into the muscles, since it appears much earlier.

The muscular symptoms brought about by this invasion are very changeable; while in the lighter forms they are but trifling, or perhaps wholly absent, they are extremely violent in moderate and in severe cases. They make their appearance at the earliest on the tenth day; it is rare for them to appear first after a much longer interval (as late as the forty-second day, Kratz). The muscles present various degrees of swelling and hardness, depending on the number of trichinæ scattered throughout them, and they are extremely sensitive to pressure; the extremities, and especially their flexors, are the parts chiefly affected, so that the joints are kept in a bent condition; in severer cases permanent contractions occur. The patients lie with their knees drawn up and with the arms sharply bent, unable to move, so that they present a picture of the greatest helplessness. The difficulties of chewing and swallowing, which often permit the reception of only fluid nourishment, are very striking; they sometimes amount to trismus.

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[1] *Ebstein*, Virch. Archiv, 40, p. 289, 1867.

Together with these perceptible objective symptoms in the muscles, there are usually more or less violent muscular pains, which are but trifling in a state of rest, but become extremely severe on motion or on attempts to stretch the limbs. This sensitiveness is most marked during the fifth and sixth weeks.

Numerous, and in some points characteristic, symptoms are observed in connection with the *nervous system.* The most prominent, and perhaps the most detrimental symptom is the almost absolute *sleeplessness* of the patients, to which children only form an exception, as they, on the contrary, often pass through almost the entire attack in a dormant condition.

An abnormal *state of mind* is not uncommon; it shows itself especially in a condition of apathy with reference to the surroundings.

During the first few days of the disease, repeated *neuralgic attacks*—neuralgia mesenterica—have been observed. More frequently there are attacks of "cœliac neuralgia," which last for various periods and return at irregular intervals, sometimes as often as six times in twenty-four hours; they appeared especially during the second week, and usually at night.

Kratz, who particularly observed this neuralgia, saw it only in the most severe forms of the disease. He once saw it as the initial symptom in the case of a boy; he awoke with a loud cry of distress, rolled around repeatedly in a convulsive manner, and between his reiterated shrieks, pointed anxiously to his abdomen and repeatedly compressed it.

Kratz found the attacks of "neuralgia cœliaca" to correspond exactly with Romberg's description: Suddenly, or after a previous sensation of compression, a violent griping pain comes on at the pit of the stomach, generally extending to the back, with faintness, a sunken countenance, coldness of the hands and feet, and small, intermittent pulse.

Very often there is *hyperæsthesia* of the skin, in the form of pruritus or formication, either extending over the whole body or limited to single portions of the lower extremities. In some cases pruritus appears very early, before the migration of the parasite. Anæsthesia is very infrequent; it increases very gradually, and in a few days, after having attained its greatest intensity, again gradually disappears.

Sometimes *mydriasis* is noticed, but it is by no means constant. Ecchymoses of the conjunctiva are not uncommon. In all severe cases there are pains in the ocular muscles, especially on motion of the eye, and they are present in about the same degree as in other muscles.

At times, a *loss of hearing* is observed, probably caused by single trichinæ in the stapedius muscle.

Of the symptoms connected with the *circulatory apparatus*, *œdema* in different parts of the body deserves chief mention, as being among the most characteristic and pathognomonic of the phenomena of trichinosis. This symptom is seldom absent, or so insignificant and transitory as to be overlooked. Most frequently and earliest—on the seventh day—œdema of the eyelids and face sets in, which vanishes after from two to five days, to return again, in some cases, after a few weeks.

The œdema of the extremities is usually more marked and more lasting; it comes on, at the earliest, on the ninth day after infection, and increases constantly, especially in severe cases, while in the lighter forms it, like the facial œdema, sometimes disappears only to return in a few days more markedly than before. Even during convalescence, after standing or walking, slight œdema not infrequently arises in the feet and legs, which disappears on lying down.

The explanation of the œdema as collateral has been repeatedly rejected as untenable. According to Klob,[1] it is dependent either on thrombosis of the finer lymph-vessels or on a plugging with trichinæ which have entered them; or, again, on the circumstance that the force, which is necessary to keep the lymph in motion, fails just at the time when the transudation is augmented in consequence of the irritation of the tissues.

Friedreich[2] maintains as exceedingly probable the opinion that the œdema is dependent on an infection of the blood with a pernicious substance contained in the capsules of the trichinæ that have been eaten, which substance, by a special influence on certain points of the vaso-motor nervous centre, engenders this transitory disturbance of circulation. He calls attention to the existence of irritating substances in Nematodes, as ascertained by various observations, and declares that the great constitutional disturbance, especially as it occurs in the beginning of the disease, can scarcely be accounted for by the existing irritation in the intestinal canal, and that, particularly, the intensity of the fever bears no proportion to the insignificance of the local symptoms of disease in the digestive apparatus, at a time when the migration into the muscles has not yet occurred.

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[1] *Klob*, Oesterr. med. Jahrb., 1866, p. 98.

[2] *Friedreich*, l. c.

Hemorrhages are, on the whole, infrequent, and usually depend upon the existence of other affections. Intestinal hemorrhages and epistaxis[1] are sometimes observed.

Changes in the composition of the blood frequently come on early, on account of the enormous consumption of muscular substance and the non-absorption of nutritious matters; marasmic thromboses are not at all uncommon.

A large number of the deaths from trichinosis are due to *insufficiency of respiration*, a consequence of the direct migration of numbers of trichinæ into the respiratory muscles, especially into the diaphragm and the muscles of the larynx. The frequent attacks of dyspnœa, which afflict the patients, even at an early stage, are dependent partly on the very same causes, and in some degree on the violent bronchial catarrh, which, almost without exception, develops exceedingly early. On account of the inability to expectorate freely, brought about in some measure by the weakened and painful condition of the respiratory and auxiliary respiratory muscles, the secretion collects in large quantities.

A more or less severe *hoarseness*, often amounting to complete aphonia, is very frequently produced by a marked invasion of the laryngeal muscles.

Hypostatic and simple *catarrhal pneumonias*, involving a certain number of lobules, are not uncommon, and present nothing characteristic of trichinosis; the physical signs of these complications are rendered difficult of recognition by the trouble and pain occasioned by moving the patient; "pleuritis sicca," with severe stitches in the side, is less common.

Kratz[2] has observed purulent pleurisy with abundant exudation.

Embolic pneumonia and metastatic abscesses must be considered as rare occurrences, and not peculiar to trichinosis; they occur as the result of the decubitus, as may happen in the later stages of any of the various exhausting diseases.

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[1] *Friedreich*, l. c.

[2] L. c., p. 91.

The symptoms attributable to the *urinary apparatus* are insignificant. The amount of urine is absolutely reduced, even from the second week on; the urine is intensely red, containing considerable sediment, but never albumen. Its increase again takes place during convalescence—in the fifth or sixth week.

Unfortunately there exist very few careful analyses of urine, which might give interesting explanations of its positive physiological and pathological relations to the enormous consumption of muscular substance.

In regard to the *sexual organs*, *abortion*, which not infrequently follows, deserves special mention; yet pregnancy often runs its entire course regularly to the end, with the normal puerperal period. Irregularities of the menses are sometimes observed, yet they are by no means constantly present, since in many patients that function remains entirely undisturbed; sometimes the menses appear prematurely; usually, however, they come on at the proper time, then they may fail once, but not often more than that.

In cases of abortion no trichinæ have ever been discovered in the fœtus.

Among the most troublesome, and in most cases never-failing symptoms, are the *profuse sweats*, which appear even in the earliest days of the disease, and continue throughout its whole course.

Eruptions on the skin are tolerably frequent, especially the miliary and pustular; other forms, as herpes, petechiæ, and prurigo, are less common; after the disappearance of the œdema, acne, ecthymatous pustules, and furuncles are of common occurrence. Mention has been made of hyperæsthesia in connection with the nervous system.

Bed-sores are tolerably common, but they seldom, however, attain a great size.

The scaling off of the skin is especially noticeable during convalescence.

Course, Duration, and Termination.

The *duration of the incubation* varies from a few hours to several weeks, according to the number of trichinæ introduced; as a rule, it is only in the severer cases that there is an approximative uniformity in the time of appearance of certain symptoms, a fixed similarity of the course. It is known that man may tolerate a considerable number of trichinæ without becoming ill; even a large number, both of intestinal trichinæ in the digestive canal and also of migrated embryos in the muscles, may be borne in the beginning without any special disturbances, while, in case of increase of the latter by a continuous influx, the bounds of tolerance will at last be suddenly overstepped, and severe, even threatening symptoms may then appear. Violent disturbances of the digestive canal occur only when a very large number of intestinal trichinæ are present.

In that case, the time of appearance of the symptoms depends upon the degree of development of the muscle-trichinæ introduced. The trichinæ must have attained a certain size, in order not to be digested in the intestine, and to be capable of development. The so-called "young trichinous" flesh causes no illness. Even should the trichinæ be sufficiently mature to be capable of development, but should not yet have attained that degree of maturity which they are capable of reaching as muscle-trichinæ, they must make up the deficiency in the intestine and consequently require a longer time for the development of embryos. Finally, if the capsules be much calcified, it seems to require a longer time to free the contents.

The *duration of the disease* is just about as inconstant as the time of appearance of the different groups of symptoms. While in some very light cases the patients may go through the whole course of trichinosis without being confined to bed, and be considered even in the third week as cured, in the majority of cases the course is very slow. In the milder cases, convalescence begins in the fifth or sixth week; in more severe and in the gravest forms it is deferred for four months, and even then the convalescents frequently do not regain their full strength for a long time.

A fatal termination of trichinosis is very common,—in single groups of cases as high as thirty per cent. It occurs most frequently in the fourth, fifth, or sixth week, and generally as a consequence of paralysis of the respiratory organs; cases of death after the seventh week are rare.

Of Kratz's 280 cases, the disease began: in 98 cases, in from 1 to 5 days, in 76, in from 6 to 10, in 67, in from 11 to 20, in 33, in from 21 to 30, and in 6, later, up to 50 days. Of 196 recoveries, convalescence occurred: in 1 case in from 1 to 5 days, in 5, in from 11 to 20, in 9, in from 21 to 30, in 46, in from 31 to 40, in 27, in from 41 to 50, in 19, in from 51 to 60, in 16, in from 61 to 70, in 15, in from 71 to 80, in 27, in from 81 to 90, in 23, in from 91 to 100, in six, after the 100th and in two, after the 120th day. Of 84 fatal cases, 10 died in from 11 to 20 days, 35 in from 21 to 30, 21 in from 31 to 40, 12 in from 41 to 50, and six later, of whom one died after the 120th day.

So tardy an appearance of the first symptoms as that quoted by Kratz[1] excites suspicion of a later infection superimposed upon the first.

The number of deaths depends on all the above-mentioned conditions governing the severity of the disease, then upon the number of those who have partaken of trichinous pork, and whether they partook of it freely; in this connection it is also a matter of importance to know whether the hog was slaughtered alone for immediate sale while fresh, or whether its flesh, either alone or together with the flesh of other animals, was used in part for fresh food, and in part preserved as sausages, hams, and the like.

Diagnosis.

In single cases the diagnosis of the trichina disease in the beginning is very difficult; it becomes easier when they occur in groups, and still more so in case of an epidemic outbreak.

In the beginning of severe cases, the symptoms of a more or less violent gastro-intestinal catarrh are almost always present, frequently accompanied by a very slight fever or none at all; at the same time, even during the first few days, an almost constant symptom is the remarkable increase of perspiration. The so-called muscular lameness has already been mentioned as the most marked initial symptom present in the mildest as well as in the most severe cases.

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[1] L. c., p. 107.

Trichinosis is distinguished from cholera by the profuse perspiration and by the peculiar muscular symptoms, from simple rheumatism by the symptoms of gastro-intestinal catarrh and by the general exhaustion.

With the appearance of œdema of the face and eyelids on the seventh day, trichinosis must naturally be suspected, and the diagnosis may then be made with greater certainty. Other diseases which may have similar symptoms can be easily excluded, especially as unilateral and chronic œdema need not be considered. Bilateral œdema of the eyelids and face occurs especially in hydræmic conditions (as in morbus Brightii) and in disturbances of the circulation, as produced by disease of the heart, lungs, or pleura; such disease can be easily excluded; the urine in trichinosis is always free from albumen. Similar œdemas occur in inflammations of the face and scalp, and also in diseases of the conjunctiva. Inflammations and neoplasms in the retrobulbar fatty tissue, even when present, are very rarely bilateral. So, also, œdema produced by thrombosis of the orbital veins, or by thrombosis of the cavernous sinus, or by compression of it, is of very infrequent occurrence.

The further progress is so characteristic that the diagnosis can scarcely remain in doubt. The marked general prostration without any noticeable disturbances of internal organs, the extraordinarily violent muscular symptoms, the attacks of dyspnœa, the hoarseness, the bronchial catarrh, the profuse sweats, and the sleeplessness scarcely admit of a doubt as to what we have to deal with.

The diagnosis becomes indisputable on the discovery of single intestinal trichinæ in the stools, or upon the observation of muscle-trichinæ in excised portions of muscle. Yet a negative result of the examination of the discharges, and of small pieces of muscle, is no evidence against the correctness of the diagnosis; it is to be remembered, on the other hand, that a positive diagnosis of the trichina disease may be made without these observations.

Well-preserved intestinal trichinæ are very seldom discharged at stool. The examination of the muscular tissue is naturally the most judicious procedure in order to ensure the diagnosis in doubtful cases; two methods—excision and the use of Middeldorpff's harpoon—are recommended for obtaining small pieces; the former is much to be preferred, as a small incision heals no less easily than a punctured wound, while a larger piece of muscle can be obtained, affording a greater likelihood of finding muscle-trichinæ; we should, however, if the diagnosis be not otherwise doubtful, refrain even from this interference.

Proof that the patient has partaken of trichinous pork or ham helps to establish the diagnosis.

Prognosis.

There is, perhaps, scarcely any other disease in which it is so difficult to form a prognosis which is in some measure positive, as in the trichina disease; this fact is due to many diverse circumstances which can scarcely be determined at the outset of the illness.

The severity, duration, and termination of each single case depend first of all upon the number of living muscle-trichinæ introduced; this depends on the number of trichinæ in the meat eaten, on the amount of it, and upon the mode of its preparation. The less thoroughly the meat is prepared, and the less exposed to heat, the more severe, *cæteris paribus*, will be the illness; the most violent cases of the disease always happen after the use of entirely raw minced meat, as is customary in a large portion of Saxony. This quasi-cannibalism has reacted terribly, as shown by the numerous victims of the epidemics.

No positive conclusions can be drawn from the severity or the premature appearance of the initial symptoms; yet, in general, the more speedily they occur after eating, and the more violent they are, the less favorable is the prognosis; on the other hand, the later they appear, the more propitious is it. A long-continued diarrhœa is especially unfavorable, while a profuse diarrhœa at the beginning is to be considered as a fortunate event. Diseases previously present in other organs aggravate the prognosis considerably.

Severe symptoms attributable to the nervous system, such as coma, delirium, and sopor, are, almost without exception, harbingers of approaching death.

The prognosis is more favorable in cases in which sleep and appetite are maintained, and in those in which the symptoms referable to the respiratory organs remain but slight.

In children a favorable termination is the rule.

Treatment.

At the present time the treatment of trichinosis does not afford a hopeful outlook. It should consist in following out two indications.

In the first place, the object should be to *kill the intestinal trichinæ*, or at least to *drive them away from their abode in the intestine*, and thus prevent the birth and migration of the embryos.

The prospect of killing the intestinal trichinæ with anthelmintics, or of removing them from the bowels by purgatives, seemed very promising. Unfortunately, this hope has not thus far been realized. Various remedies have been tried; they were in part allowed to exert their influence directly on the muscle- or intestinal trichinæ, and the results tested either by feeding experiments or with the microscope; to some extent, also, the animals which had been fed with the trichinous flesh were treated with the various medicaments; all these experiments have given negative or very doubtful results; we have not yet succeeded in finding a remedy which, in a quantity innoxious to man, will positively kill the trichinæ

Observation having shown that in patients, who in the beginning had a profuse diarrhœa, the disease ran a more favorable course, it was hoped that better results would be obtained by the employment of purgatives. But this expectation also has not been fulfilled.

The prospect of killing the migrated muscle-trichinæ is thus far just about as hopeless.

Nevertheless we should not give up the hope of finding a remedy which will kill the trichinæ in the intestine.

Picric acid, in the form of picronitrate of potassa and soda, is recommended by Friedreich[1] as a very efficient anthelmintic even in the treatment of intestinal trichinæ; according to Fiedler's experiments, it prevents neither the development of the intestinal trichinæ nor the formation and migration of the embryos.

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[1] *Friedreich*, Virch. Archiv, 25, p. 399.

Mosler[1] has seen favorable results from benzine in a few experiments; yet these have not been confirmed either on more accurate experimental examination or at the bedside (Kratz).[2] Compare Fiedler's experiments.[3]

Glycerine which causes the shrivelling and death of the trichinæ by depriving them of water, proved of no value in two of Fiedler's experiments; yet in a number of other cases it seems to have exercised decided effects. Mature intestinal trichinæ ten days old, live, at the furthest, a quarter of an hour in a mixture of one part of glycerine to four parts of water; they are then, however, distinctly shrivelled; in mixtures of one part of glycerine to three of water, they shrivel in a few minutes; it may be asked whether it is advisable to administer it continuously for any length of time, a single day, for instance, in a sufficiently concentrated solution to cause the shrivelling of the intestinal trichinæ,—in other words, to administer for some length of time pretty large quantities of glycerine in the strength of not less than one part in three or one part in two of water, as the solution is weakened still more by the absorption of water from the organism. Thus far no experiences have been recorded bearing on this point; a colleague, however, suffering from diabetes, has taken pure glycerine in tablespoonful doses without detriment.

In addition to these, cold, warmth, and electricity are recommended, then common salt, calomel, santonine, oil of turpentine, and in particular the various cathartics, and an almost incredible number of other remedies; even less success is to be expected from all of these than from those already mentioned.

The results obtained by treatment of the symptoms do not seem to be any more favorable.

We cannot recommend allaying the *vomiting and diarrhœa* in the beginning with opium, as perhaps a number of trichinæ may thus be expelled in a purely mechanical manner; subsequently, in the long-continuing exhausting diarrhœa, mucilaginous decoctions and emulsions are proper; in treating the persistent constipation which is met with so frequently, the different purgatives, especially calomel, should be given.

In case of *muscular pains* little can be done; mild embrocations with warm oil, and irritation of the skin sometimes produce temporary relief.

For the treatment of the *insomnia*, as also of the *profuse*

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[1] *Mosler*, Helmintolog. Studien und Versuche, p. 57, and Berlin. klin. Wochenschr., 1864, No. 32, and *Leuckart*, Virch. Archiv, 29, p. 467.

[2] *Kratz*, l. c., p. 114.

[3] *Fiedler*, Archiv der Heilkunde, V., p. 18, 1864, and Virch. Archiv, 26, p. 573, 1863.

sweats, Kratz recommends a cool regimen, especially frequent cold baths of the whole body; hydrate of chloral will also be of service.

On the occurrence of attacks of *dyspnœa*, expectorants are indicated, after which the benzoated tincture of opium may be administered, in doses of from thirty to sixty drops in water.

Bandaging alleviates the troublesome *œdema* of the limbs.

The occurrence of *bed-sores* is to be prevented by the use of large rubber water-pillows.

Pneumonia and *pleurisy* require, in particular, a tonic treatment.

The most careful attention should be paid to the diet; it should be light and nutritious; meat and good wine must be given to keep up the strength, so as to preserve the life of the patient until the disease reaches the period when the parasites become capsulated.

PATHOLOGICAL ANATOMY.

The number of careful dissections made of those who have died of trichinosis is still proportionately small, and our information is especially lacking as to the conditions found in those who have died in the first few weeks of the disease. According to experiments on animals, as well as to the clinical symptoms, there can only be a moderately marked injection of the gastric and intestinal mucous membranes.

Peritonitis has not been seen by any of the careful investigators of the disease in man, or in the innumerable experiments on animals; for that reason the general peritonitis observed by Leuckart in his first experiment on a hog may be attributed to some other cause.

In case of moderate infection of rabbits, during the first weeks, we find scarcely any increased redness of the intestine, either of the mucous membrane or of the serous; only the follicular apparatus is somewhat swollen, and the serous surfaces are generally moister.

The bodies of those who die in the fourth week usually show moderate œdema of the lower extremities; in the case of those dying in the fifth and sixth weeks, the œdema is excessive; the rigor mortis is characterized by a rigid contraction of the arms;

bed-sores of more or less extent are not uncommon; the blood has very little tendency to coagulate; in the pericardium, and in the abdominal and thoracic cavities, large effusions are found; putrefaction sets in very early.

The *mucous membrane of the small intestine*, as a rule, presents here and there a distinct reddening, with sometimes slight ecchymoses; still later it is for the most part pale, and the solitary follicles are frequently swollen, and the mesenteric glands swollen and pulpy; we meet with intestinal trichinæ in the large and small intestine as late as the eighth week.

The cases in which living intestinal trichinæ containing embryos have been found in the eleventh week may perhaps be attributed to repeated introductions of trichinous meat.

The *spleen* is either not at all enlarged, or but very little. After the fifth week the *liver* shows a well-pronounced fatty degeneration; the surface appears entirely smooth and pale yellow, and the tissue poorly supplied with blood, and of a doughy consistence; surface of section bright yellow. Microscopically all the liver-cells prove to be filled with larger and smaller fat globules.

The connection between trichinosis and fatty liver has not yet been explained. Cohnheim[1] supposes that on account of its great propensity to react with all variations of nourishment and changes of texture, this alteration of the liver may be explained by the enormous and rapid destruction of muscular substance.

As a rule, the *kidneys* present a marked opacity of the cortical substance. The *muscular tissue of the heart* seems for the greater part tolerably firm, though sometimes it is rather flabby and weak; microscopically we frequently find a distinct granular cloudiness. At a later date, about the eighth week, Cohnheim once found extensive fatty metamorphosis of the kidneys and of the heart.

Answering to the *respiratory symptoms*, a severe bronchial catarrh is commonly found; the mucous membrane, even down to the finest ramifications, seems of a dark-red color, and covered with abundant, tenacious mucus. The dependent portions of the lungs generally present the results of hypostatic processes:

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[1] *Cohnheim*, Virchow's Archiv, 36, p. 161, 1866.—*Zenker*, l. c.—*Fiedler*, l. c.

quite frequently simple, indolent infiltrations, or isolated lobular hepatizations. In very rare cases hemorrhagic infarctions and gangrene are observed.

The gangrenous mass found in the lung in the case at Plauen (Böhler, p. 70) was dependent, undoubtedly, upon the gangrenous bed-sore.

During the first few weeks the *muscles* show no constant changes, yet they often appear paler and somewhat cloudier; their consistence is variable; at one time they are soft, at another, uncommonly hard; changes visible to the naked eye appear from the end of the fifth week on, and then only in severe cases; fine, clear, grayish streaks, of from one-half to one or even two millimetres in length, appear running in the direction of the muscular fibres, and the more distinct they are, the darker the remaining muscle. These appearances are the optical expressions of the changes wrought in the individual muscular fibres by the trichinæ. In slighter cases small, widely separated, pale—changing to gray—specks are only sometimes visible on the surface of the muscle. At a still later date, in the tenth week, for instance, the muscles are shrunken to the greatest extent, and generally very pale; in these, even if not yet clearly defined, are the delicate capsules, recognizable even to the naked eye, and they give the muscle a peculiar scaly appearance.

In the slighter cases the distribution of the trichinæ over the muscular system is unequal. They are generally most numerous in the diaphragm, the intercostal muscles, and the muscles of the neck and larynx; and they are found least often in the distant muscles of the extremities. In severer cases no difference can be recognized; whole muscles are so thickly spotted that sometimes far fewer fibres seem free than occupied. In the superficial layers of single muscles, especially, however, toward their tendinous extremities, the trichinæ are more numerous than in the remaining portion. This condition reminds us of Zenker's apt comparison to a picture of a herd of cattle or a crowd of men, whose advance is suddenly checked by some obstacle; the tendons are such an impediment to the trichinæ. This stoppage demonstrates at the same time that the trichinæ travel in the direction of the fibres.

The muscles have been arranged according to the frequency of infection and number of trichinæ found in them. According to Cohnheim, the most frequently affected is the diaphragm, then the intercostal and the cervical and laryngeal muscles, and after them the muscles of the eye.

The *microscopic appearance*[1] of the muscles has, to some extent, been previously mentioned. During the first few days after immigration, the substance of the muscular fibre appears altered around the trichina, which lies still in an extended position within it; it has lost its transverse and longitudinal striæ, and is converted into a more or less finely granular mass; the muscle nuclei seem beyond a doubt to have increased in number; in addition there is a proliferation of the nuclei in the intermuscular connective tissue; fine spindle-shaped cells arranged in rows are found, and between them are single ribbon-like cells, each containing several nuclei.

Subsequently the sarcolemma becomes thickened over the places occupied by the trichinæ; there is formed around them a dense network of vessels; the muscle nuclei around the coiled trichinæ increase so much in number that the animals seem to be imbedded altogether in them; between the nuclei may still be seen, although only in slight amount, a very finely granular, light-yellowish mass.

The sarcolemma is continued, in both directions, for a long distance between the glittering normal muscular fibres, as a collapsed tube with doubly contoured shining walls, and dark, granular (fatty) contents. In the seventh week Zenker found heaps of these crowded, small, round cells around the pole of the capsule, while they were absent in the remaining muscular tissue.

Later, the much-thickened sarcolemma is further strengthened from without by a layer of connective-tissue nuclei and spindle cells; in the interior the muscle nuclei are deposited in numerous, regular layers (perhaps plastered over by a chitinous exudative product of the trichinæ), and form the boundary of the free cavity.

While these changes are taking place both in those muscular fibres which are occupied by trichinæ, and in those in their immediate neighborhood, simple *fatty degeneration* sets in in many other bundles; the fibres lose their transverse striæ and seem to become atrophied.

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[1] *Zenker*, Deutsches Archiv f. klin. Med., VIII., p. 393. *Fiedler*, l. c.

Then follows occasionally the *waxy degeneration*, which Zenker has described as occurring in the muscles, particularly in typhoid fever; it never occurs, however, in so marked a degree, or so uniformly distributed. A few bundles of fibres lose their transverse striæ, and become waxy and dull in appearance; their transverse diameter is increased, and they very easily fall into larger and smaller fragments, of similar appearance, around which the sarcolemma sheath still remains.

The waxy degeneration of the muscles has occasioned much discussion; it has been denied by some that it is a morbid change appearing during life. In a rabbit which had for many months outlived the infection with trichinæ, waxy degeneration was found which had evidently persisted in a peculiar manner since the time of the illness; whole muscles, especially those of the abdominal walls, were thickly set with trichinæ, and appeared coarse, whitish, speckled, and striped. Microscopically, at first sight, these places presented exactly the appearance of a well-marked waxy degeneration; the muscular fibres had to some extent maintained their form over large tracts, yet without the transverse striæ, and with small and large fissures in places on the margin; here and there large and small fragments were found in the sarcolemmatous sheaths, of the form, appearance, and position found in waxy degeneration, only all these pieces appeared, like the remaining fibres, far more glassy, diaphanous, and inflexible. It was finally ascertained that they had all become fixed in these forms through calcification. The preparation is now in the Pathological Museum at Erlangen.

ETIOLOGY.

At the same time with the detection of the trichina disease, Zenker showed also that the source of man's infection was the hog, in which, up to that time, trichinæ had been seen only once. Although it has since then been proved that numerous wild animals are affected, yet in Europe these can be considered in connection with man only in the case of gypsies, and under exceedingly abnormal conditions of civilization. First of all, therefore, we are interested in the hog.

To determine the question, to what extent trichinæ are present in hogs, would require a more general microscopic inspection of meats than has thus far been practised ; yet the results of such examinations are even now sufficient to show how widespread the prevalence of trichinæ among hogs may be.

In the city of Brunswick [1] 93,099 hogs were examined microscopically between 1866 and 1872, of which number 18 were trichinous, that is, one in 5,172 ; in Blankenburg, during the same period, seven out of 17,933 hogs were trichinous, *i.e.*, 1 : 2,562. In Rostock,[2] of 4,034 hogs examined in the half-year 1867–68, 12 were found trichinous. In Sweden,[3] from 0.38 per cent. to 1.6 per cent. of all hogs inspected were infested.

The use of salted American bacon, which is now imported in large quantities, seems to be exceedingly dangerous.

Of 622 sides of American bacon examined in Rostock,[4] 12 were found trichinous (1 : 52) ; of 210 imported into Gothenburg,[5] 8 showed trichinæ ; in Elbing,[6] one in every twenty contained them ; in Holstein, too, numerous specimens of American bacon were trichinous.

In 1873, in Bremen, 40 persons were taken ill with trichinosis, caused by the use of a ham imported from America.

The question of next greatest importance is, whether the hog is the original host of the trichinæ, and, if not, where and in what manner it acquires them. It was formerly supposed that certain breeds of hogs were the only carriers ; but, with the discovery of trichinæ in neighborhoods into which these breeds had never been introduced, and with the proof also that trichina epidemics had occurred at a time previous to the importation of these species, this theory was abandoned.

Gerlach (l. c., p. 74) claims that the Chinese hogs were the original "bearers" of trichinæ, and considers it very probable that they brought the parasites to Europe, as the time of the first discovery of the trichinæ coincides with that of the importation of this breed.

Some writers—especially those but little versed in the natural sciences—have endeavored to establish a connection of the trichinæ with all other varieties of round worms; in their opinion the round worms in the red beet, the earthworm, that in the mole, the different round worms in birds, etc., were but developmental stages of trichinæ, and were capable of infecting the hog. All these suppositions were very soon disproved.[1]

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[1] *Uhde*, Virch. Archiv.

[2] *Petri*, Ibid.

[3] *Axel Key*, Ibid., 41, p. 302, 1867.

[4] *Petri*, Ibid., 57, p. 296, 1873.

[5] *Axel Key*, l. c.

[6] *Jacobi*, Vierteljahrsschrift f. gerichtl. Med., etc., N. F., 20, p. 103, 1874.

Leuckart's successful experiments in feeding the hog with intestines containing trichinæ seemed to afford the most simple explanation of the way and means by which the hog is infected. From the known habit of this animal to wallow around in filthy places, and to devour vegetable and animal products of all kinds, it seemed very obvious that it became affected by swallowing intestinal trichinæ which had been evacuated by those suffering from the disease. This mode of infection must certainly be extremely infrequent, for, first of all, intestinal trichinæ have but rarely been found in the discharges; and besides, investigations of this subject have shown that intestinal trichinæ, like embryos, are infallibly destroyed in the stomach. The successful experiments depended most probably on feeding at the same time with muscle-trichinæ which had not yet escaped from their capsules, and had been prematurely discharged in consequence of diarrhœa.

Amongst those animals which are often the bearers of trichinæ, attention was particularly directed to rats as the true source of the hog's infection. Not only was their ready susceptibility experimentally proved, but spontaneously trichinous rats were discovered in all the various places in which they had had opportunity of feeding upon trichinous meat. Investigations made upon a large scale among wild rats resulted in the discovery that these also were frequently found to be infested, and often very severely diseased, even in neighborhoods in which the trichina disease in man had not been at all observed, or but seldom. The well-known voracity of the hog, and its special fondness for meat, made it extremely probable that these rats were occasionally devoured; and it was afterwards proved (by Kühn, l. c.) that such was really the case. Reasoning from these observations, the theory that hogs, and indirectly also man, derived their trichinæ from rats, appeared to be sufficiently supported to be accepted with more or less confidence by the majority of investigators. "According to this 'rat theory' (Zenker), the trichinæ are originally and essentially parasites of the rat. They are directly kept up in the rat species by continual propagation from rat to rat (independently of their importation from other sources, such as trichinous flesh). Trichinæ, indeed, are communicated from rats to other animals, especially to swine (but also to cats, foxes, etc.), and indirectly to man; but this is not essential to the maintenance of the trichinous species. Without a continual fresh importation from rats, the trichinæ in these other animals would soon die out."

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[1] *Virchow*, Archiv, 32, pp. 349–351.—*Fiedler*, Archiv d. Heilkunde, V., p. 345.

"To exterminate the rat is to exterminate trichinæ" (Leisering).

The most decided representative of this view, to which he still adheres, is Leuckart. Leisering,[1] to whom we are indebted for the fundamental material to be hereafter mentioned, likewise defends it, but does not consider it as yet completely established. Virchow takes a similar position with reference to it.

Zenker,[2] making use of Leisering's data, has given convincing proof of the incorrectness of the "rat theory," and has shown that the rats which have been found trichinous came, almost without exception, from flaying places, slaughter-houses, etc., in short, from places where the flesh of dead and slaughtered hogs is always met with; that they therefore derive their trichinæ in the first place from the flesh of other trichinous animals, and not from their own species; hence the fact (according to Gerlach), that it is only in times of great scarcity of animal food that rats feed upon the bodies of their own species, which cannot of course be the case in the places mentioned. The objection, that no swine are delivered to the flaying yards, is refuted by a reference to the lists of those places. Gerlach's proposition, that "whenever trichinæ are found among rats, there must have been trichinous hogs or other carnivora within their reach," is fully maintained. The hog is the peculiar and original bearer of trichinæ; in it the whole course of evolution of the trichinæ takes place; in it the trichinæ are propagated from generation to generation, and from it, as a rule, man, the rat, and the cat derive their trichinæ.

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[1] *Leisering*, Bericht über das Veterinärwesen im Königreich Sachsen für d. Jahr 1865, p. 97.

[2] *Zenker*, Deutsches Archiv f. klin. Med., VIII., p. 401.

Of 704 rats collected from 29 different districts of Saxony, Bavaria, and Austria, and from one place in Würtemberg, 59 were trichinous, = 8.3 per cent.

Of these	208	rats from	flaying yards,	46	were trichinous	= 22.1	per cent.
"	224	"	slaughter-houses,	12 "	"	= 2.3	"
"	272	"	other localities,	1 was	"	= 0.3	"

The one trichinous rat from another locality was, however, "found dead in the street" in Vienna, and therefore proves very little. Rats from eighteen different flaying places were examined, and those coming from fourteen of them were found trichinous; the negative results in the remaining places were probably due to the small number examined.

After the figures just given, Leuckart's adherence to the rat theory (Archiv fur Naturgeschichte, 1871, 2 Band, p. 431), and his observations upon it, are entirely inexplicable.

While, therefore, the hog is the only source of man's infection, it (the hog) may acquire the trichinæ in different ways.

Among such we may mention: 1st, the infection induced by swallowing the excrement of men and hogs suffering from trichinosis, and with it intestinal trichinæ and embryos, but probably also muscle-trichinæ which have not yet escaped from their capsules.

This mode of infection has not succeeded with the majority of experimenters, but nevertheless it seems to have done so in a few cases (Gerlach, l. c., p. 14).

The second mode of infection is by eating the trichinous flesh of another hog. This may occur in two ways. First of all, Zenker has proved that, under the present modes of management, "the flaying yards, in which swine are crowded, are the most prolific breeding-places for trichinous hogs that can be imagined," for the flayers are permitted to feed the scalding meat to the dogs, poultry, and hogs on their premises. That they should see nothing wrong in thus disposing of or even selling hogs which to them seem innocuous, is only natural, and, as a rule, these hogs pass through several hands before they are slaughtered, so that the place from which they originally came cannot always be correctly traced.

It is therefore not at all remarkable that the number of trichinous hogs manifestly traceable to flaying places should already be tolerably large;[1] the first group of cases of trichinosis positively recognized in Corbach, in 1860, originated in a hog bought from a flayer; and the same was true of the hog which occasioned the Hettstadt epidemic. In Holstein four trichinous hogs were traced to flaying yards, two each in two successive years.[2]

Zenker very correctly supposes that hogs which have died in some other way have likewise been used by butchers and breeders as food for the remaining hogs on their places.

The third mode, to which Zenker calls special attention, is the custom which prevails not only in the yards but also in the slaughtering establishments of feeding the hogs with the waste meat.[3] The practice of pouring into the feeding-trough the water with which the tables, boards, chopping-blocks, and implements have been washed is widespread and perhaps universal; and in this way the numerous small pieces contained in the furrows on the surface of the chopping-block are removed with the water, and, in case they come from a trichinous hog, may be sufficient to infect others. Even if the infection be only moderate, it may still bring on severe illness; and, if the same course be pursued after slaughtering one of these animals, the remaining hogs will be for the second time supplied with trichinæ, and so on.

The discovery of trichinous droves is convincing proof of the foregoing views; by this we mean, cases in which hogs have repeatedly become trichinous in one and the same sty, on the same premises, at intervals of months, a year, or more. Virchow had already directed attention to this and similar practices, which caused the infection of hogs by the intestinal discharges of men suffering from trichinosis. Zenker's explanation of the origin, namely, by feeding the waste scraps in slaughtering, is more simple and obvious. A series of such experiences might be readily adduced.

Of those cited by Zenker, the case occurring in Basedow, Mecklenburg-Schwerin, in which twenty-three trichinous swine were found in one yard, is particularly interesting. It was expressly observed in this case that they had been fed upon kitchen garbage. Compare also Bockendahl, l. c.

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[1] *Zenker*, l. c.

[2] *Bockendahl*, Generalbericht über das öffentlich. Gesundheitswesen der Prov. Schleswig-Holstein. Kiel, 1872, p. 7, and 1873, p. 6.

[3] Compare also *Gerlach*, l. c., p. 67.

We shall not, of course, deny that hogs occasionally become infected by eating trichinous rats; yet this is but a slight deviation from the general rule, and it is not at all probable that the modes mentioned cover all the possible methods of infection.

The innocuousness of fly larvæ, in connection with the extension of trichinæ, is positively determined by the frequently repeated observation, that the trichinæ are perfectly digested in their intestinal canal.[1]

Prophylaxis.

In view of the present hopeless state of our treatment, prophylaxis becomes of all the greater importance. Its object is a double one; the first is, to protect man himself from the trichina-disease, and the second, to guard the hog, whose flesh cannot be excluded from our food, from the acquisition of trichinæ.

In order to accomplish the former object, first of all the sale of trichinous meats must be prevented. This can be attained only by an obligatory microscopic inspection of meat, such as has been demanded ever since the discovery of the trichina-disease,[2] and, guided by this, it is to be hoped that no one will ever again witness such terrible sacrifice of life as was once caused by this malady. The objections to this are, of course, numerous, and the difficulties encountered in its general execution extraordinarily great; these, however, should not prevent it from being carried out, for the experience of several cities has shown that these difficulties are by no means insurmountable.

In the first place, droves of trichinous hogs are to be carefully watched.

A voluntary microscopic inspection of meats is only a half-way measure, which usually lulls the population into a false sense of security, and, as a rule, is soon neglected altogether.

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[1] *Probstmayr*, Virch. Archiv, 30, p. 265, 1864.

[2] *Virchow*, Trichinen, 3 Aufl., p. 70.—*Zenker*, Deutsches Archiv f. klin. Med., VIII., p. 392.—*Gerlach*, l. c., p. 75.

The microscopic examination has been practised in the duchy of Brunswick since 1863, and has produced excellent results.[1]

It has acted similarly in other localities.

The microscopic investigation should be made before the meat of the animal is manufactured into the various preparations, and sold. It is always best to choose certain portions of each animal, such as the muscles of the larynx and diaphragm. Butchers and meat inspectors should be required to keep a careful record of the hogs; the former should especially note the source of each hog, in order, by means of those found to be trichinous, to point out the stables, and thus destroy other droves coming from them. The microscopic inspection should be undertaken only by persons particularly skilled in the use of the instrument, especially by physicians, veterinary surgeons, apothecaries, or other persons peculiarly fitted in this respect.

The proper method of making a microscopic inspection of meats must be learned; but it is not too difficult for those who are not altogether inapt. Small portions, following the direction of the fibres of the muscle to be examined, should be removed with fine scissors, and placed upon a glass slide, with a little water; the fibres may be easily separated. A thin glass, smaller than the slide, is used as a cover, and lightly pressed down upon the preparation, which can then be seen with a low magnifying power, while any suspicious points can be examined more carefully with a stronger lens. The addition of a solution of soda or of caustic potash renders the muscle more translucent.

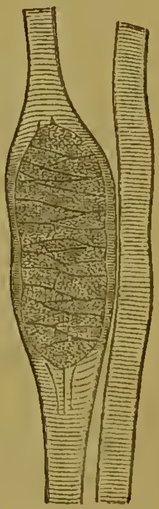

FIG. 41.
A Miescherian sac, from a pig. (Moderately magnified.)

There are different sources of error to be guarded against, chief among which are the Miescherian (or Raineyan or psorospermian) sacs. These were first found in 1843 by Miescher[2] in mice, in 1847 by Rainey[3] in hogs, and afterwards in numerous other animals (horses, sheep, cows, rats, etc.). They are sausage-shaped bodies, of various lengths, which lie within the primitive bundles of muscular tissue, but do not fill them completely. They seem to be furnished superficially with irregular transverse lines, and with a delicate homogeneous border. I have examined fresh preparations, and those hardened by alcohol and chromic acid, but I have been as unsuccessful in seeing any glittering investment as have Virchow and others.

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[1] *Uhde*, Virch. Archiv, 35–58.

[2] Verhandlungen der naturforsch. Gesellschaft zu Basel, 1843, p. 143.

[3] Philosoph. Transact., 1857, p. 114.

The statements made with reference to this point depend upon a delusion, and its source appears to be in that portion of muscular substance yet remaining in the sarcolemma sheath around the Mieschcrian sac. This almost constantly presents a more finely striated appearance than do other parts of the same fibre; for example, within five divisions of the eye-piece micrometer I counted, at three different portions of this remaining muscular fibre, 12, 13, and 12 transverse lines, and in other portions of the same fibre of corresponding size, 8, 9, and 9. At the end of the sac the transverse striæ of the muscular substance seem very indistinct and irregular.

On being cut or torn, these sacs discharge numerous little, crescentic, boat-shaped, or kidney-shaped bodies—the so-called pseudo-naviculæ—which are capable of changes of form. Their nature, origin, and development are still completely vailed in darkness. No morbid derangements caused by eating meat containing these sacs have yet been observed. It is only in the hog that their presence in large numbers may occasion such troubles.

In a rabbit, which had been fed with highly trichinous meat, Zenker[1] saw, in addition to numerous living trichinæ in the muscles, a number of trichinæ evidently dead and decayed, yet still retaining their form, and distinctly recognizable. They had a granular appearance, which was caused by their being crowded with such corpuscles, like the Mieschcrian sacs. Zenker propounds the question, whether these sacs should not be considered as dead animal parasites, in whose investment the thickly crowded (probably vegetable) parasites develop. Kühn[2] has made similar observations.

The peculiar concretions described by Virchow,[3] as the "guanine-gout" of swine, form another source of possible error. They consist of needle-like crystals closely heaped together; on the addition of hydrochloric acid they dissolve, and leave the muscular substance with its fibres seemingly unchanged.

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[1] Verhandlungen der phys.-med. Societät zu Erlangen, 1865–67, p. 20.

[2] *Kühn*, l. c., p. 68.

[3] Virch. Archiv, 35, p. 358; 36, p. 147; 43, p. 548.

In one hog innumerable white chalky granules were found deposited by the side of, and in and around, the knee-joint. Without entering upon a chemical distinction, these changes bear a decided resemblance to those of human gout. The reactions are very similar to those of guanine; when treated with fuming nitric acid, the latter is colored intensely red, and on evaporation a yellow residue is formed, which, on the addition of caustic soda, becomes red, and on heating, purplish red. Kühn found several properties, such as partial solubility in strong ammonia, which seem to indicate hypoxanthine.

Other concretions sometimes met with consist of carbonate and phosphate of lime, with an admixture of oleine and stearine (Gerlach, l. c.), or of stearine and margarine (Leuckart); still other concretions have proved to be dead calcified trichinæ, with hyperplasia of the connective tissue in the neighborhood.[1]

A round worm, named by Diesing *Stephanurus dentatus*, but which has lately been described by Verrill and Fletcher[2] as *Sklerostoma pinguicola*, frequently appears in American hogs; it is most generally found capsulated in the neighborhood of the pelvis of the kidney, or even in the latter itself, but also occurs in the fatty tissue, and in other places. The animals affected are often lame in the hips. The worm occurs frequently in Australia also. It will scarcely ever be the occasion of mistakes.

In regard to the authority for the adoption of an obligatory meat inspection, legal decisions have been variously interpreted;[3] yet the authority is perhaps scarcely doubtful. An indirect proof of it is, the judicial condemnation of butchers for careless killing in the sale of trichinous meat.[4]

A remarkable decision has been made by a court in Bremen; it is, that, under No. 7, section 367, of the penal code, only the retailing of trichinous meat, not, however, the wholesale dealing in it, is illegal; and that therefore the former and not the latter is punishable. A definitive legal solution of this question is a pressing necessity.

The efficiency of the obligatory microscopic inspection is more controverted than the legal authority for it. Of course, there can be no doubt that single trichinous hogs may escape the notice of the most scrupulous inspector, if the number of parasites be very small. Such meat will, however, never produce very severe illness, since the number of trichinæ taken by one person must be exceedingly limited. Culpable negligence[1] may also occasion such an occurrence, but this should not be placed to the charge of the regulation itself.

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[1] *Wiederholt*, Virchow's Archiv, 23, p 549, and *Müller*, Ibid., 37, p. 253.

[2] Silliman's American Journal, 1871, I., pp. 223 and 435.

[3] Compare *Jacobi*, Vierteljahrschrift f. gerichtlich. Med., N. F., 20, p. 103, 1874, and *G. Merkel*, Aerztl. Intell.-Blatt f. Bayern, 1866, No. 12, p. 161, and *Renz*, l. c.

[4] *Otto*, Memorabilien, 1869, No. 10 (Jahresbericht, 1879, I., p. 448).

The assertion that the distribution of the trichinæ throughout the hog is altogether irregular, is entirely incorrect; on the contrary, it is so constant that we can positively declare that, if no trichinæ be found in the muscles above recommended for examination, none will be discovered in other parts of the hog, or, if any, they will occur only in very exceptional cases.

The case at Calbe[2] only serves as a caution against improper inspections.

A microscopic inspection of American bacon is an indipensable measure.

Of about equal importance with the microscopic inspection of the meat, are the precautions by which to guard individuals from the acquisition of trichinæ. In the first place, the use of raw or partially raw pork is most decidedly to be condemned; only well boiled or roasted meat should be eaten. Experience, as well as extensive investigation, has taught us that trichinæ will tolerate a high degree of heat without losing their capability of development, as very frequently, by the common modes of preparation, large pieces of uncooked meat may be obtained from the interior of the mass. According to Fiedler's investigations, trichinæ are surely killed by a temperature of from 142° to 155° F. (perhaps at even a lower temperature; according to Gerlach at 133° F.). Such a temperature, however, is obtained in the interior—especially in the neighborhood of bones—only after long roasting or boiling. It will suffice, as a general rule, when the inside of the meat is no longer red or rosy, much less bloody, but gray or grayish-white. Sausages and cutlets, which become dry and tasteless on long cooking, are particularly dangerous, and their use should either be entirely desisted from, or only carefully examined meat should be used in making them.

Salting and smoking, unless done very thoroughly, afford no protection against infection; only a long continuance of these processes, which depend essentially on the exclusion of water, kills the trichinæ. The common smoking alone, such as is customary in preparing the various kinds of sausages, like the "quick curing," guarantees no protection whatever. According to Haubner, the curing by heat is the only mode which secures from infection.

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[1] Compare *Jacobi*, l. c.

[2] *Simon*, Virch. Archiv, 34, p. 623.

Those who may have any interest in reading the numerous experiments can find them recorded in the works of Rupprecht, Haubner, Gerlach, Fiedler, and others.

Tasting raw meat, as practised by butchers and cooks, has already made numerous victims; such bits of meat should never be swallowed.

The second object, that of guarding the hog from the acquisition of trichinæ, must be attained by stopping all possible sources from which it may receive them.

First, it is the duty of the sanitary police authorities to close those abundant sources in the flaying yards. For this purpose, there must be clear and unequivocal legal authority, which will positively prohibit the flayers from holding, feeding, and slaughtering hogs, either for their own use or for sale. The enforcement of this rule will entirely control it.

Hogs found trichinous should be boiled under police supervision, and the refuse, in which a few trichinæ may still be found, should be buried in such a manner that animals—rats in particular—can never reach it.

Such measures should be carried out very carefully, on account of the great power which trichinæ possess of withstanding putrefaction; they still live in perfectly fluid putrefying flesh, and remain capable of development as long as a hundred days.[1]

Then, too, swine must be kept at a distance from all places where there might be an opportunity of eating excrement or garbage of any kind; in general, they should be kept cleaner than has been the custom hitherto.

The infection of hogs by feeding the waste matter in slaughtering to the remaining swine, can only be averted by the judgment and conscientious sense of the farmer. In order to attain this end, instructions should be furnished both in agricultural journals and in schools; Zenker's concise axiom must be made part of the farmer's flesh and blood: "When slaughtering hogs, nothing, not even the least of the cuttings, and none of the kitchen garbage at the time, or for some time after the slaughter, should be thrown into the hogs' feeding-trough. Therefore, on these occasions, even dish-water should be kept away from them."

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[1] Wiener Comité-Bericht, Oesterr. med. Jahrb., VIII., p. 74, 1867.

It is scarcely necessary to mention that rats should be kept away from piggeries, in order to close such accessary sources; their extirpation is particularly indicated in places in which trichinous swine are already present, and where whole droves of hogs have become infected.

All these measures are rendered the more important by the fact that, according to the uniform results of numerous experiments, the recognition of the trichina disease in hogs is generally impossible, or possible only in the severest cases.

NOTE.—During the correction of this article I have received, through the kindness of Prof. Jürgensen, "Miller, Dissert. inaug., Tübingen, 1874," in which the case of echinococcus multilocularis mentioned on page 566 is reported. The patient was a woman, forty years of age. The duration was one year. It began with jaundice during the puerperal period. There was an enormous hepatic tumor, with fluctuation. Simon's operation was performed. Death occurred ten days afterwards. A cyst, of the size of a child's head, was found in the ulcerating echin. multiloc. in the right lobe of the liver. In the fluid, urea, chloride of sodium, chloride of potassium, 0.2 per cent. of albumen, etc., were found.

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